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PHYSICS ABSTRACTS

SECTION A

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SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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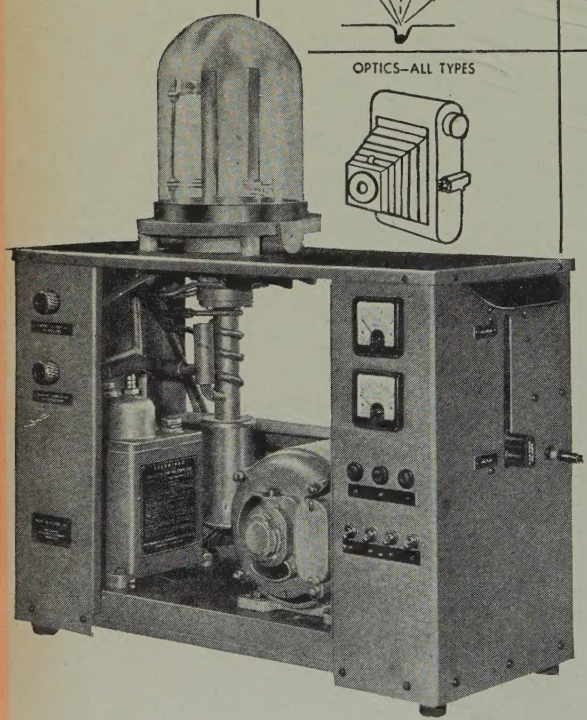

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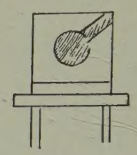

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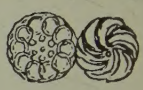

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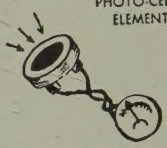

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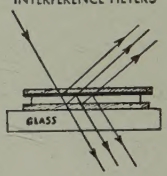

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Electrical and magnetic measurements and instruments	Photocells	Amplifiers
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MATHEMATICS 51

513.468

8620. Some remarks concerning close-packing of equal spheres. A. H. BOERDIJK. *Philips Res. Rep.*, **7**, 303–13 (*Aug.*, 1952).

For estimating the mean density in local regions of configurations of equal spheres three criteria are stated. Some configurations are described, which have in certain regions a local mean density exceeding that of close-packing. These regions may even have an infinite volume. Further, it is proved that the maximal number of spheres simultaneously touching a sphere is 12. A conjecture of Fejes concerning a 14th sphere added to this configuration is shown to be false. A.

513.76

8621. Transformation amplitudes for vector addition of angular momentum; ($j3mm'|j3JM$). D. L. FALKOFF, G. S. COLLADAY AND R. E. SELLS. *Canad. J. Phys.*, **30**, 253–6 (*May*, 1952).

517.5

8622. Orthogonal functions in the complex domain. G. IWATA. *Progr. Theor. Phys.*, **7**, 333–44 (*April*, 1952).

Eigenfunctions associated with an operator in the complex domain constitute a system of orthogonal functions along the path of integration in the complex plane. There are orthogonal functions free from operators, examples of which are given. At the end of this paper are collected some transformation functions constructed with orthogonal functions. A.

517.6

8623. Numerical values of error integrals for $\sqrt{n\pi}$. O. EMERSLEBEN. *Z. angew. Math. Mech.*, **31**, 393–4 (1951) *In German.*

The values of $H[\sqrt{(n\pi)}]$, where $H(x) = (2/\sqrt{\pi}) \int_0^x \exp(-t^2)dt$ are given for $n = 1(1)10$. The value for $n = 1$ has been computed to 17 decimals from the power series. The values for $n = 2(1)10$ are given to 15 decimals and have been found by interpolation in National Bureau of Standards Tables of Probability Functions I (1941). For $n \geqslant 11$, $H[\sqrt{(n\pi)}]$ is unity, to 15 decimals. The values are used in the computation of certain Epstein zeta functions.

MATHEMATICAL REVIEWS

518.2 : 535.43

8624. Tables of light-scattering functions for spherical particles. xvi + 574 *pp.* **Tables of Riccati Bessel functions for large arguments and orders.** xvi + 260 *pp.* **Tables of functions of first and second partial derivatives of Legendre polynomials.** xii + 310 *pp.* R. O. GUMPRECHT AND C. M. SLIEPCEVICH. *University of Michigan Engineering Research Institute, Special Publications. Ann. Arbor*, 1951.

Reviewed in *Math. Tables Aids Comput.*, **6**, 95–7 (*April*, 1952). The tables provide data for spheres of circumference up to 400λ.

518.5

8625. Automatic programming of programme-controlled computers. H. RUTISHAUSER. *Z. angew. Math. Phys.*, **3**, 312–13 (*No.* 4, 1952) *In German.*

To simplify programming various devices have been constructed, but the author believes that the device most suited to assist the coding personnel is the computing machine itself. A.

518.5 : 621.317.79 : 621.311.6

8626. A source of computing voltage with continuously-variable output. R. W. WILLIAMS AND G. M. PARKER. *J. Sci. Instrum.*, **29**, 322–4 (*Oct.*, 1952).

A circuit employing a magslip feedback resolver is described which provides an alternating voltage output suitable for use in analogue computers. The output amplitude is an accurately linear function of the angular position of the resolver rotor. The circuit offers the advantages of very low internal impedance and freedom from the discontinuities in output voltage variation which are commonly observed when resistance potentiometers are used as sources of computing voltage. A.

518.5 : 519.241.1

8627. A photoelectric correlation meter. M. J. TUCKER. *J. Sci. Instrum.*, **29**, 326–9 (*Oct.*, 1952).

The instrument draws cross- or auto-correlograms from data which is in the form of black and white "variable-area" records: it is suitable for records containing information equivalent to about 500 numbers. The time taken to draw a typical correlogram is 20 min. If necessary, data can be replotted in the required form with the help of an automatic curve-follower (for continuous curves) or a digital plotter (for numbers). A.

518.5 : 621.318.572

8628. The serial-memory digital differential analyzer. J. F. DONAN. *Math. Tables Aids Comput.*, **6**, 102–12 (*April*, 1952).

A small, compact machine which handles computations in binary digit form, and operates most suitably with magnetic drum storage. The discussion is limited to a résumé of the logic and block-circuit arrangements of the computing operation.

A. J. KENNEDY

518.5 : 621.318.572

8629. Decision elements. J. D. GOODELL. *Radio-Electronic Engng* (1952) 3–5 (*July*).

The general theoretical problem treated is that of the synthesis of computers into basic units. The *decision element* is defined as a unit with one or more inputs and one or more outputs, where the outputs are uniquely defined by the input pattern. Such elements are classified and special symbols developed to represent them. All programme and arithmetic structures can be set up in terms of one universal element, and this can be extended to storage structures by adding pulse delay systems. A. J. KENNEDY (R)

518.5 : 621.318.572

8630. Decision elements. II. J. D. GOODELL. *Radio-Electronic Engng* (1952) 14–16, 23 (*Aug.*).

The treatment of Pt I (preceding abstract) is extended to the problem of full serial binary addition, and the question of universal decision elements reconsidered. In particular, the possibility is examined of establishing a structure which is a function of 4 variables and which has the property that by suitably connecting the 4 inputs it is possible to produce any of the 16 possible decision elements for 2 variables. This is shown to be logically realizable, and provides a general purpose device from which any portion of any digital computer (with the exception of the input and output facilities) can be constructed. A. J. KENNEDY

518.5 : 621.318.572

8631. An electronic computer. M. BEARD AND T. PEARCEY. *J. Sci. Instrum.*, **29**, 305–11 (*Oct.*, 1952).

A serial binary digital computer using mercury acoustic tubes for the main store of 1 msec access time. A low-speed store of magnetic drum type raises the total digit capacity to 40 960 binary digits, or 2 048 separate numbers. The command code is of the "two-address" type in which a source and a destination are specified. Programmes are placed in the high-speed store and commands are adopted sequentially at a rate of 500 per sec. Full facility for making conditional or absolute changes in the uniform sequence of commands is provided. A.

519.2

8632. On the theory of prediction of nonstationary stochastic processes. R. C. DAVIS. *J. Appl. Phys.*, **23**, 1047–53 (*Sept.*, 1952).

The following problem of prediction is considered: During a finite time interval T the real valued function $S(t) + N(t)$ is observed, in which $S(t)$ is a signal and $N(t)$ is a linearly superimposed noise disturbance. The problem is to predict the value of a given linear functional of $S(t)$, the predictor formula having certain preassigned "optimum properties" among a certain class of predictors. In the case in which the mean value of $S(t)$ is known, the random components of $S(t)$ and $N(t)$ are strictly stationary, and the time interval T is infinite, a complete solution to this problem has been given by N. Wiener. (In the case of discrete time series, the solution was given by A. Kolmogoroff.) This theory has been extended by L. Zadeh and J. Ragazzini [Abstr. 6944 (1950)] to the case in which T is a finite time interval and the mean value of $S(t)$ is unknown but is restricted to be a polynomial in time. The above theories are extended to the case in which the random components of both $S(t)$ and $N(t)$ are nonstationary in time and merely possess finite continuous covariance and cross-covariance functions. The analytical tools of probability theory used are those developed independently by M. Loève and K. Karhunen in their studies of a class of stochastic processes usually termed processes of second order. Apparently these techniques are practically unknown outside of certain mathematical circles. In the opinion of the author these techniques are extremely powerful in the analysis of transient random phenomena in linear systems. Finally, an exposition is given of a method of prediction by the theory of conditional probabilities. This method is applicable when the form of the joint probability distribution of signal and noise is known and hence is applicable to many practical problems, since this distribution is often Gaussian. In this particular case the predictor formula given by the theory of conditional probabilities is identical with the usual linear predictor formula given by the theory of least squares. In case the signal is a Markoff process, the method of conditional probabilities yields a much simpler prediction formula than the usual method of least squares. A.

519.2 : 621.392.52

8633. The theory of prediction and filtering of stationary random series [séries aléatoires], after Norbert Wiener. III. H. JACOT. *Ann. Télécommun.*, **7**, 325–35 (*July–Aug.*, 1952) *In French.*

The approximations necessary in particularizing the general formulae of the previous parts [Abstr. 7874–5 (1952)] to the specific cases of filtering and prediction are discussed, and in conclusion the modifications necessary when only discrete values of the amplitude function are known (as is always the case in practice) are enunciated. G. D. SIMS (R)

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.165

8634. Occultation of a radio star by the solar corona. K. E. MACHIN AND F. G. SMITH. Letter in *Nature* [*Lond.*] **170**, 319–20 (*Aug.* 23, 1952).

The occultation of the Taurus radio star (05·01) has been observed with interferometer aerials on 81·5 and 38 Mc/s. Existing estimates of coronal electron densities indicate that a well-defined occultation should occur on 38 Mc/s at a separation ~5·2 solar radii, little effect being observed on 81·5 Mc/s. A decrease of amplitude was observed simultaneously on both frequencies at a separation of 10 solar radii. The observed effects might be due either to an actual reduction in flux density or to an apparent increase of the angular diameter of the radio star caused by irregularities of electron density in the outer corona. M. W. OVENDEN

523.165 : 551.510.535

8635. Interstellar matter and ionospheric disturbances leading to flicker of radio-stars. V. L. GINZBURG. *Dokl. Akad. Nauk, SSSR*, **84**, 245–8 (*No.* 2, 1952) *In Russian.*

The flicker of the radio-stars is due to influences of the terrestrial ionosphere and has a marked maximum at 1 a.m., local time. The ionospheric disturbances responsible for the flicker are believed to be due to interstellar matter falling into the sun and passing

through the earth's atmosphere at an orbital velocity of 42·5 km/sec, a relative velocity of 52 km/sec and an angle of incidence of 35° with the vertical. This would yield maxima of the particle flow occurring at 2.20 and 8.20 a.m. and 8.20 p.m., roughly corresponding to actual observations. The question of the nature of these agents, i.e. whether they are gas atoms or cosmic dust, is considered in the paper which also points out that the screening effect of the moon might be used for testing the two possible hypotheses. The theoretical analysis carried out shows that only cosmic gas particles could produce the ionized clouds in the *F*-layer which are necessary for flicker phenomena of the kind observed. B. F. KRAUS

523.165 : 551.510.535

The diffraction of galactic radio waves as a method of investigating the irregular structure of the ionosphere. *See Abstr.* 9230

523.165

8636. Solar and cosmic radiowaves. H. H. KLINGER. *Experientia*, **8**, 325–64 (*No.* 9, 1952) *In German.*

A short summary is given of the more important results and problems of the new branch of research in radio-astronomy. The solar radio frequency radiation can be traced back to 3 different components of radiation: one a constant thermic radiation from the (spot-free) sun (undestroyed or stationary radiation), one a radiation emitted by the sun-spots (sun-spot radiation) and one an eruptive component (eruptive radiation). Cosmic radio waves are, according to the present state of our knowledge, mainly sent out in the intra-galactic space from the radio stars whose nature is still unknown. A lesser part of the cosmic radio frequency is emitted also from extra-galactic star-systems, and a quite small radiation component, which is practically without significance, arises from the inter-stellar gas. Attention is drawn to possible connections between the cosmic radio waves and cosmic corpuscular radiation, and in conclusion the relationship is discussed between cosmic and solar radio waves and other branches of science. A.

523.165 : 523.841.11

8637. Radio-frequency radiation from Tycho Brahe's supernova (A.D. 1572). R. H. BROWN AND C. HAZARD. Letter in *Nature* [*Lond.*] **170**, 364–5 (*Aug.* 30, 1952).

A faint radio star has been discovered with the 218 ft parabola in the position of the supernova of 1572. The possibility of this source being a spurious diffraction image of the nearby bright Cassiopeia source was discounted by demonstrating the incoherence of the radiation of the neighbouring sources with an interferometer system. Comparison with the Crab nebula shows that the difference of 2·5 magnitudes between the brightnesses of the radio stars equals the difference in visual brightness of the two supernovae at maximum, although any visible remains of the nova of 1572 (so far none have been detected) must be visually at least 6 magnitudes fainter than the Crab nebula. M. W. OVENDEN

523.165 : 523.852.32

8638. Spiral structure and interstellar radio emission. J. H. OORT. *Mon. Not. Astron. Soc. S. Afr.*, **11**, 65–70 (*July* 31, 1952).

A brief summary of the relationship between inter-stellar matter and spiral structure in galaxies is followed by a report and discussion of the observations of the fine-structure of the 21·1 cm emission line by Muller which delineate a spiral arm of our own galaxy. M. W. OVENDEN

523.2

8639. Recurrence of planetary orbits. II. Orbital velocity. L. SINGH. Letter in *Sci. Cult.*, **18**, 37–8 (*July*, 1952).

For Pt I, see Abstr. 6996 (1952). The orbital velocity v of a planet is related to the orbital number N. $v^2 = 600/N$, and the equatorial velocity of rotation V to the diameter d, $V = 0{\cdot}2877\ (d/D)^{1{\cdot}37}$ where D = diameter of the earth. M. W. OVENDEN

523.53

8640. Ionizing and luminous efficiencies of meteors. J. S. GREENHOW AND G. S. HAWKINS. *Nature* [*Lond.*] **170**, 355–7 (*Aug.* 30, 1952).

Accurate electron densities for meteor trails are found from the proportionality of electron density with duration of the long-duration echoes from over-dense trails, diffusion coefficients being found from the durations of short-duration echoes which obey the Lovell–Clegg formula. The relation between visual magnitude and electron density is deduced from data by Millman and McKinley, the visual brightness so deduced being some 5 magnitudes fainter than that given by Herlofsen's theory. Adoption of Opik's theoretical values for luminous efficiency and ionization probability brings closer agreement of theory with observation. For Perseid meteors, $K \sim 0{\cdot}005 - 0{\cdot}001$, $S \sim 0{\cdot}02$, the ratio of heat : light : ionization being $10^4 : 10^2 : 10$ for bright meteors and $10^4 : 10 : 10$ for faint meteors. M. W. OVENDEN

523.7 : 528.877

8641. Is the sun a pulsating star? L. GIALANELLA. *Ric. Sci.*, **22**, 853–63 (*May*, 1952) *In Italian.*

The daily measures of the sun's diameter, carried out without interruption since 1874 at the Observatory of Rome, show fluctuations possibly in coincidence with the 22 yr period of activity shown by the sun itself. In 1925 Armellini deduced that the sun was a pulsating star. The recent discovery of star magnetism and of the mechanic-magnetic pulsations which are likely to exist in some stars, led the author to examine Armellini's assumption in the light of cosmic electromagnetism. A.

523.72

The determination of the energy flux of the sun's extraterrestrial radiation. M. NICOLET. *Arch. Meteorol. Geophys. Bioklimatol. B*, 3, 209–19 (1951) *In French.* For abstract, see Abstr. 8700 (1952).

523.72

8642. Solar outbursts at 8·5-mm wave length. J. P. HAGEN AND N. HEPBURN. Letter in *Nature* [*Lond.*] **170**, 244–5 (*Aug.* 9, 1952).

The outbursts, correlated with solar flare activity, were observed with a 24 in aperture aerial of beam width 1·1°. A single observation of simultaneity of occurrence at 8·5 mm and 3 cm is significant in that for this burst a transport of material as the source of burst energy is highly improbable. M. W. OVENDEN

523.77

8643. On the coronal lines λλ 5445, 5694, and 4086. R. H. GARSTANG. Note in *Astrophys. J.*, **115**, 569–70 (*May*, 1952).

Transition probabilities are computed for Ca XV, and the previous tentative identification of coronal lines with Ca XV are shown to be incorrect. Transition probabilities are also given for Ca XIII, and the line 4086 might be identified with this source.

D. L. EDWARDS

523.813

8644. General catalogue of trigonometric stellar parallaxes. L. F. JENKINS. *Yale University Observatory* (1952) 253 *pp.*

This is the third edition of Schlesinger's General Catalogue, containing parallaxes and probable errors for nearly 6000 stars. Due to the sparsity of new material in dynamical and spectroscopic values, it was decided to limit the publication to trigonometric values obtained photographically. The introduction describes the intercomparison of results from all observatories to derive true probable errors. The catalogue information is printed as previously, but is confined to the left-hand pages, leaving room on the right-hand pages for the notes and individual relative parallaxes and weights for each star. The Henry Draper Catalogue number (when available) has been inserted on the left-hand pages. An appendix lists all the parallaxes published in decreasing order. The catalogue was printed with financial aid from UNESCO and the author formerly collaborated with Schlesinger. E. G. MARTIN

523.82

8645. The influence of titanium oxide bands on the visual magnitude and amplitude of long period variable stars. R. F. E. VAN DER BORGHT. *S. Afr. J. Sci.*, **48**, 402–6 (*July*, 1952).

The influence of titanium oxide absorption bands on the visual magnitude of long period variable stars is investigated. It is also shown that the difference between radiometric and visual amplitude can be explained if the band absorption, corresponding to maximum and minimum effective temperature, is taken into account. For stars of very low temperature condensation in the stellar atmosphere, as proposed by P. W. Merrill, must also be considered. A.

523.87

8646. Formation of absorption lines by noncoherent scattering. M. P. SAVEDOFF. *Astrophys. J.*, **115**, 509–28 (*May*, 1952).

The problem of noncoherent scattering, with and without selective absorption, has been solved by iterating the exact integral equation for $\bar{J} - B$, for the case where ε and η_ν are independent of depth. The first iteration introduces a correction which is of the order of 15% of the zero-order solution for $\varepsilon = 0$ and $\tau > 0{\cdot}01$ and is less than 4% for $\varepsilon = 0{\cdot}01$ and $\tau > 0{\cdot}001$. The differences from pure absorption are therefore secure. Line contours, even for $\varepsilon = 0$, lie very close to the pure absorption solution except for the line centre and for small μ. Exact values of $\bar{J} - B$ are given for $\varepsilon = 1$. Deviations from pure absorption are shown to be proportional to $\varepsilon\eta_0^{1/2} + (1 - \varepsilon)(\eta_0/1 + \eta_0)^{1/2}$, which measures the coupling with the thermal emission. Tables are given from which the zero-order solutions for any ε, η_θ and β can be obtained. A.

523.872

8647. A note on the concept of effective wavelength. I. KING. Note in *Astrophys. J.*, **115**, 580–2 (*May*, 1952).

A note pointing out the different interpretations of the term "effective wavelength" in use. The two main uses are defined with a warning of the effects of attributing to one definition the properties of the other. E. G. MARTIN

523.877

8648. Anharmonic pulsations of a polytropic model of index unity. L. D. CHATTERJI. *Proc. Nat. Inst. Sci. India*, **18**, 187–91 (*May–June*, 1952).

The anharmonic pulsations of a polytropic model of index unity are investigated. It is found that the first overtone gives a skewness to the radial velocity curve. The value comes out to be small when compared with the observed value, and the increase in the period is found to be slight. A.

526.7

8649. Report on gravimetric measurements carried out at points of the basic gravimetric network during 1948 and 1949 on the territory of Czechoslovakia. J. PÍCHA. *Czechoslovak. J. Phys.*, **1**, 24–6 (*No.* 1, 1952).

PHYSICS 53

FUNDAMENTALS 530.1

530.12

8650. Energy of an isolated fluid sphere. P. C. VAIDYA. Letter in *Curr. Sci.*, **21**, 95–6 (*April*, 1952).

An expression obtained for the energy within a sphere of radius R in the gravitational field defined by $ds^2 = e^\gamma dt^2 - e^\alpha dr^2 - e^\beta r^2(d\theta^2 + \sin^2\theta d\phi^2)$ is stated to be valid when R varies with t. R. A. NEWING

530.12

8651. On relativistic theory of rotating disk. H. TAKENO. *Progr. Theor. Phys.*, **7**, 367–76 (*April*, 1952).

From the group-theoretical point of view, using the composition law of velocities in special relativity, a relativistic theory of the rotating disk is established by an axiomatic method. First a transformation formula from the Galilean frame to the disk frame is obtained and then the velocity distribution and the

intrinsic geometry of the disk are determined. The distribution satisfies the linear law in the limit of $\rho\omega/c \to 0$, although not in general. The geometry is not Euclidean and its Gaussian curvature is negative in spite of the fact that the proper circumference of any circle with centre 0 (the centre of rotation), is obtained in Euclidean manner. A.

530.12 : 530.145

8652. Relativistically invariant homogeneous canonical formalism with higher derivatives. J. WEYSSENHOFF. *Acta Phys. Polon.*, **11**, 49–70 (*No.* 1, 1951).

Ostrogradsky's canonical formalism with second derivatives in the Lagrangian function has been put in "homogeneous form" in which an arbitrary parameter plays the part of time in classical dynamics or proper time in relativistic dynamics. This doubly generalized canonical formalism makes it possible to treat the motion of a spin particle in a generally relativistic manner, independently of the velocity of the particle being less or equal to the velocity of light. Weyssenhoff's and Raabe's equations of motion of a spin particle and Hönl's and Papapetrou's equations of motion of a pole-dipole particle are both included as special cases in the new equations of motion. A.

530.145

8653. Relativistic two-body problem. H. KITA. *Progr. Theor. Phys.*, **7**, 217–24 (*Feb.*, 1952).

Starting from the Feynman theory inhomogeneous and homogeneous integral equations are obtained relativistically for scatterings and bound states of two particles respectively, in connection with the *S*-matrix theory. A.

530.145

8654. "Weisskopf–Wigner method" in *S*-matrix formalism. D. ITÔ. Letter in *Progr. Theor. Phys.*, 7, 326–7 (*March*, 1952).

The Weisskopf–Wigner expressions for the amplitude of a decaying state are obtained from the *S*-matrix formalism by summing the terms of the usual power-series expansion in a suitable order. R. H. DALITZ

530.145

8655. Angular momentum in the quantum theory of wave fields. G. MARX. *Acta Phys. Hungarica*, **1**, 209–33 (*No.* 3, 1952) *In German.*

For wave fields described by a higher order Lagrangian, the symmetric energy-momentum tensor is obtained and the angular momentum of the field is unambiguously separated into orbital and spin terms, the spin being determined by the transformation properties of the state function. R. H. DALITZ

530.145

8656. Remarks concerning a paper by Wilker. R. W. ISKRAUT. *Helv. Phys. Acta*, **25**, 305–6 (*No.* 3, 1952).

The equation $dr/dt = \partial r/\partial t + [r, H]$ is shown invariant w.r.t. homogeneous canonical transformation if $\partial r/\partial H = 0$, a weaker condition than that obtained by Wilker [Abstr. 2415 (1952)]. R. H. DALITZ

530.145

8657. Statistical interpretation of the Klein–Gordon equation. J. RZEWUSKI. *Acta Phys. Polon.*, **11**, 1–8 (*No.* 1, 1951).

A quantum-statistical interpretation permits calculation of cross-sections without use of field quantization. A.

530.145

8658. Field theories without divergences. J. RZEWUSKI. *Acta Phys. Polon.*, **11**, 9–24 (*No.* 1, 1951).

A quantum-statistical interpretation is given for the extended source theory of Peierls and McManus. It is shown that by use of this theory only the electron self-energy is made finite. To remove other divergences it is necessary to average the extended source Lagrangian with an appropriate weight factor over the mass of the electron. Higher-order equations are discussed and it is shown that for any neutral field they are equivalent to the extended source theory. For charged fields they lead to non-gauge-invariant results. In general all physically interesting possibilities seem to be already contained in the Lagrangians with first-order derivatives of the fields. A.

530.145

8659. On field theories with non-localized interaction. J. RAYSKI. *Acta Phys. Polon.*, **11**, 25–35 (*No.* 1, 1951). For abstract see Abstr. 764 (1952).

530.145

8660. On the energy-momentum tensor of Bopp-type non-local field. Y. ÔNO. *Progr. Theor. Phys.*, **6**, 925–38 (*Nov.–Dec.*, 1951).

Expanding the characteristic function $\varepsilon(x)$ in the Lagrangian in derivatives of $\delta(x)$ and applying the variation principle of general relativity, the symmetrical energy-momentum tensors were obtained for the Bopp-type non-local fields. They are free from the defects accompanying the expressions proposed by Bopp and Heisenberg and can be regarded as the most natural extension of the local fields. A.

530.145

8661. On Yukawa's theory of non-local field. I. The case of free field. O. HARA AND H. SHIMAZU. *Progr. Theor. Phys.*, **7**, 255–62 (*Feb.*, 1952).

The relation of Yukawa's non-local field theory [Abstr. 3762 (1950); 2367 (1951)] to the ordinary local field theory is investigated. It is shown that the equations of motion and the commutation relations of the non-local field are derived from those of the local field by a canonical transformation, which means that both fields are equivalent at least in the case of no interaction. The non-local field as a mixed field composed of those with various spins is discussed. The considerations in this paper are all restricted to the free field. A.

530.145

8662. The general discussion of the self-stress. Y. TAKAHASHI AND H. UMEZAWA. Letter in *Progr. Theor. Phys.*, **7**, 330–1 (*March*, 1952).

For a wide class of local field theories of an elementary particle, the self-stress is shown to vanish in all orders. R. H. DALITZ

530.145 : 530.12

8663. The mass variation with velocity in Bopp's unitary field theory. I. M. SUGAWARA. *Progr. Theor. Phys.*, **7**, 303–16 (*March*, 1952).

In the case of free motion of constant velocity, the total energy and total momentum of self-field produced by a point particle was calculated starting

from the energy-momentum tensor derived by Bopp and Heisenberg for the Bopp-type non-local field theory. The correct velocity variation of energy and momentum required by relativistic mechanics is not guaranteed from the beginning for the above energy-momentum tensor. From the detailed calculations in this paper, however, the correct variation upon velocity is attainable if the characteristic function $\varepsilon(x)$ satisfies a certain condition. As this condition is very flexible, there remain possibilities of the presence of some appropriate form of $\varepsilon(x)$ which guarantees the finiteness of the self-energy of a point particle and the correct velocity variation of energy and momentum of the self-field. The examination of the energy-momentum tensor itself causes some doubt about the correctness of the energy-momentum tensor derived by Bopp and Heisenberg. A.

530.145

8664. On Lagrangian and Hamiltonian formalism. Y. NAMBU. *Progr. Theor. Phys.*, **7**, 131–70 (*Feb.*, 1952).

The theory of transformation functions, as has been developed by Schwinger, Feynman, Dyson and others, is investigated systematically with mechanical models, keeping close analogy to classical theory; and a new light is thereby thrown on the relation between the Lagrangian and Hamiltonian formalism. In these investigations the idea of chronological ordering introduced by Dyson on the one hand, and a differential operation with respect to coupling constant (or some other parameters) on the other, play a decisive part. The formulation is extended to a point where dynamical systems with higher time derivatives as well as "non-local" systems (with integral equations of motion) are included. A.

530.145

8665. On the analytic behaviour of Dyson transformation function. H. SUURA, Y. MIMURA AND T. KIMURA. *Progr. Theor. Phys.*, **7**, 171–84 (*Feb.*, 1952).

The detailed properties of the Dyson transformation function, which represents the time development of an initial free state at infinite past due to an interaction, adiabatically switched on and off according to a factor $\exp(-\varepsilon|t|/\hbar)$, $(\varepsilon > 0)$, were examined in special connection with bound states. The transformation function is unitary and the power expansion in the interaction Hamiltonian is finite and regular in the limit $\varepsilon \to 0$, except for those matrix elements with respect to the lowest energy free state of the system in question. An initial free state except that of lowest energy is transformed at a finite time t into the corresponding unbound eigenstate of the total Hamiltonian with the same energy. Transitions to bound states are due to those initial states whose energy falls in the interval of the order ε from that of the lowest energy state. A.

530.145

8666. Transformation function in quantum electrodynamics. Y. KATAYAMA. Letter in *Progr. Theor. Phys.*, 7, 265–7 (*Feb.*, 1952).

Schwinger's equations [Abstr. 64–5 (1952)] for the Green's function in quantum electrodynamics are obtained following a discussion of the transformation function $U(\sigma_1\sigma_0)$ in interaction representation.

R. H. DALITZ

530.145

8667. Note on the physical connection between electron's electromagnetic mass and its charge. K. BABA. Letter in *Progr. Theor. Phys.*, **7**, 328–9 (*March*, 1952).

The contrast between the observability of electron charge and the unobservability of its electromagnetic mass is briefly discussed. R. H. DALITZ

530.145

8668. On the Green-functions of the quantum electrodynamics. R. UTIYAMA, S. SUNAKAWA AND T. IMAMURA. Letter in *Progr. Theor. Phys.*, **7**, 328 (*March*, 1952).

The relation of Schwinger's discussion [Abstr. 64–5 (1952)] of the Green's functions in quantum electrodynamics to the functions and equations of Dyson [Abstr. 4487 (1949)] is summarized. R. H. DALITZ

530.145

8669. Meson-nucleon scattering. Y. NAMBU AND Y. YAMAGUCHI. *Progr. Theor. Phys.*, **6**, 1000–6 (*Nov.–Dec.*, 1951).

Using the symmetry properties in the charge space, the relationships between various modes of meson-nucleon scattering are discussed. The connection between this formalism and meson theories is also given. A.

530.145

8670. Meson reactions in deuterium and meson-nucleon scattering. Y. YAMAGUCHI. *Progr. Theor. Phys.*, 7, 93–103 (*Jan.*); *Erratum*, 267 (*Feb.*, 1952).

Various meson reactions in D are investigated on the basis of impulse approximation. Then the close connection between deuteron data and nucleon data is obtained, which is shown to be useful to get an insight into the spin- and charge-dependences of meson-nucleon interaction. Brief discussions of available results of experiments are also given. A.

530.145

8671. On the renormalization theory of the interaction of electrons and photons. G. TAKEDA. *Progr. Theor. Phys.*, 7, 359–66 (*April*, 1952).

Using the transformations of Lagrange, the connection between existing renormalization theories of the interaction of electrons and photons is examined. A.

530.145

8672. On the structure of the interaction of the elementary particles. I. The renormalizability of the interactions. S. SAKATA, H. UMEZAWA AND S. KAMEFUCHI. *Progr. Theor. Phys.*, **7**, 377–90 (*April*, 1952).

The applicability of the renormalization theory was investigated for the general types of the local interactions. It was found that the interaction having the coupling constant of the dimension L^η could be renormalized if the conditions $\eta \leqslant 0$ were valid. It is remarkable that this condition is closely related to Heisenberg's classification of the interactions. A.

530.145

8673. On the renormalization in quantum electrodynamics. S. KAMEFUCHI AND H. UMEZAWA. *Progr. Theor. Phys.*, **7**, 399–405 (*April*, 1952).

With this procedure, the finite S-matrix can be automatically obtained by use of the modified commutation relations and propagation functions and,

herefore, without introducing the counter terms of ass- and charge-types. The various significant eatures of this new renormalization procedure are lso discussed. A.

530.145

8674. On the deduction of various variational principles in collision theory from a single principle. T. KAHAN AND G. RIDEAU. *J. Phys. Radium*, **13**, 326–32 (*June*, 1952) *In French.*

For the equation $L\phi = \psi$ (L a symmetric linear operator) a variational principle is given, from which the variational methods proposed by Schwinger, Hulthen, Kohn and others for scattering problems are shown to follow. R. H. DALITZ

530.145

8675. Bound states and the interaction representation. S. T. MA. *Phys. Rev.*, **87**, 652–5 (*Aug.* 15, 1952).

The temporal development of the state vectors in the interaction representation is investigated for a quantum-mechanical system that has bound states. It is shown that there is a non-unitary operator which determines the variation of the state vectors of the free states. This operator satisfies the same differential equation and initial condition as the unitary operator which transforms a state vector at the remote past to the state vector at a finite time or in the remote future. The present investigation is relevant to a remark made by H. S. Snyder [Abstr. 8526 (1951)]. No iteration process is made use of in the general investigation. Born's method of successive approximations is discussed at the end. A.

530.145

8676. The calculation of scattering amplitudes. G. J. KYNCH. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 708–18 (*Sept.*, 1952).

In two earlier papers (Abstr. 2431–2 (1952)] a differential equation was given for the asymptotic phases required in the two-body scattering problem. The method implied a resolution of the wave function into eigenfunctions of the orbital or total angular momentum as the potential was central or non-central. This feature can be avoided and in this paper an integro-differential equation is given for the total scattering amplitude corresponding to a given incident wave. It can be applied to any scattering or ionization problem, single or multiple, where no particles are bound after scattering which were not bound before. The method is applicable to the Schrödinger or Dirac equations. If used with time-dependent equations the usual time-dependent perturbation theory results, owing to the apparent necessity of adhering to a definite time distinction between initial and final states. The same is true for the quantized field equations in the Heisenberg representation. A.

530.145

8677. The scattering of elementary particles by complex nuclei—a generalization of the impulse approximation. G. F. CHEW AND M. L. GOLDBERGER. *Phys. Rev.*, **87**, 778–82 (*Sept.* 1, 1952).

By a systematic iteration procedure it is shown how the problem of the scattering of an elementary particle by a complex nucleus (or any many-particle target system) can be expressed in terms of two-body operators. The results are related to the previous work of Chew and Wick [Abstr. 3301 (1952)] on the impulse approximation, with special attention given to multiple scattering effects which have heretofore not been formulated in a rigorous way. An explicit formula for the double scattering terms is presented. A.

530.145 : 539.165

8678. On the mesonic correction to the β-decay. T. KOTANI, S. MACHIDA, S. NAKAMURA, H. TAKEBE, M. UMEZAWA AND T. YOSHIMURA. *Progr. Theor. Phys.*, **6**, 1007–12 (*Nov.–Dec.*, 1952).

General types of mesonic correction to β-decay are obtained from the invariance requirements. Explicit calculations are performed, using Feynman–Dyson method, up to the second order of meson-nucleon coupling constants for the symmetrical pseudoscalar meson theory with both pseudoscalar and pseudovector couplings. It is shown that the mesonic correction is small and does not affect the selection rules and spectra in the Konopinski forbidden theory. A.

530.145

8679. On the mass difference of nucleons and the cohesive mesons. H. ENATSU AND PONG YUL PAC. *Progr. Theor. Phys.*, **6**, 665–72 (*Sept.–Oct.*, 1951).

In 2nd order, the nucleon self-mass is shown finite in scalar cohesive meson (C) theory, and the observed $n - p$ mass difference results for suitable meson mass: however, 4th-order self-masses diverge. Cross-sections for processes $\pi^- + P \rightarrow N + C$ and $\gamma + P \rightarrow P + C$ are calculated in 2nd order and shown to be small compared with observed π^0-meson cross-sections. R. H. DALITZ

530.145

8680. On the self-energies of mesons. K. YAMAZAKI AND H. ENATSU. *Progr. Theor. Phys.*, **6**, 731–6 (*Sept.–Oct.*, 1951).

To 2nd order, a formal expression is obtained for the self-energy of a meson of spin 0 or 1 for each of the usual meson-fermion couplings, and it is pointed out that, for psc. mesons, the divergences in these expressions cannot be cancelled by mixing of fermion fields. R. H. DALITZ

530.145

8681. Note on the Bloch–Nordsieck's method. G. TAKEDA, Y. TANIKAWA, T. TANIUTI AND K. SAEKI. *Progr. Theor. Phys.*, **6**, 994–9 (*Nov.–Dec.*, 1951).

The Bloch–Nordsieck method has been applied to mesonic systems by several authors. Here the convergence character of this method is examined and shown to be about the same as that of the current perturbation method. So the B–N method will be unsuccessful if the current perturbational treatment is incorrect for mesonic systems. A.

530.145

8682. Remarks on the adiabatic nuclear potential. S. MACHIDA AND K. NISHIJIMA. *Progr. Theor. Phys.*, **7**, 57–68 (*Jan.*, 1952).

The validity and approximation method of the adiabatic nuclear potentials are discussed, especially

of the fourth-order nuclear potential derived from pseudoscalar meson theory. It is shown that effects of the time component of pseudovector coupling on the pseudoscalar meson potential are not large when distance between two nucleons is larger than about half of the force range. Time variation of nucleon spin and τ-spin are evaluated for phenomenological and meson potentials, and critical radii for their applicability are derived. Implications of the velocity-dependent forces in the interior region are discussed, and the extent of the purely quantum mechanical effects in the meson theory is pointed out. A Hamiltonian for a two nucleon system in the intermediate coupling approximation is given. Features of the meson-nucleon interaction are compared with that of the photon-electron interaction. It is pointed out that the transition matrix of the nucleon-nucleon collision is not analytic with respect to nucleon energy at the threshold for meson production. An ambiguity occurs when the sixth-order nuclear potential is calculated. A.

530.145 : 539.172.3

Meson production by γ-rays. *See Abstr.* 9053–4

530.145

8683. On the so-called pseudo spinors. K. Goto. *Progr. Theor. Phys.*, **6**, 990–3 (*Nov.–Dec.*, 1951).

The behaviour of spinors under space and time reversal is summarized, with the emphasis that the convention usually adopted is not the only possible one. R. H. DALITZ

530.145

8684. The unitary transformation and the quantization. G. Iwata. *Progr. Theor. Phys.*, **7**, 39–44 (*Jan.*, 1952).

Particle mechanics, classical as well as quantum, being observed to be representations of the unitary transformation of finite dimensions, field mechanics is formulated as the representation of the unitary transformation of infinite dimensions. A.

530.145

8685. Theory of super-quantization of quantized field and its applications. Y. Tanikawa. *Progr. Theor. Phys.*, **7**, 193–206 (*Feb.*, 1952).

A new treatment of quantum field theory is proposed by applying the theory of super-quantization of quantized field. For examples of its application, it is shown that the symmetrical treatment of the four potentials of electromagnetic field is justified without introduction of the indefinite metric for the scalar photon, and the physical interpretation of the regular theory of Bose field may be given. A.

530.145

8686. On the physical interpretation of wave mechanics and the hypothesis of hidden variables. J.-L. Destouches. *J. Phys. Radium*, **13**, 354–8 (*June*, 1952) *In French.*

For a system S and measuring apparatus a_A, the system $S + a_A$ formed by the union of S and a_A must be distinguishable from the pair S/a_A formed by S in observation through a_A. An objective deterministic description of S/a_A (depending on fictitious hidden variables) exists, making the same predictions concerning A as does wave mechanics for the system S, though no such description exists for S or $S + a_A$. A similar description can be given also for another quantity B (even if not measurable simultaneously with A) in the same phase space as for A. R. H. DALITZ

530.162

8687. A correction to the Fermi kinetic energy. R. Paunts. *Acta Phys. Hungarica*, **1**, 277–84 (*No.* 3, 1952) *In Russian.*

In integrating over the Fermi sphere associated with solutions in a cubical box, disk-like slabs along the coordinate planes are left out to allow for the absence of identically vanishing ψ. An adjusted effective maximum momentum leads to kinetic energies approximating to the exact sums. W. J. SWIATECKI

530.162

8688. Statistical mechanics of cooperative phenomena. T. Nakamura. *Progr. Theor. Phys.*, **7**, 241–54 (*Feb.*, 1952).

The method of attack developed by Kirkwood and Born–Green, whose application was almost exclusively confined to the theory of liquids, is applied to the statistical treatment of co-operative phenomena (i.e. the order-disorder problem), its related phenomena and the hindered rotation in molecular crystals. Using Kirkwood's coupling parameter, an integral equation is found which is simplified by a method of expansion. By a further simplification two kinds of integral equations are reached, corresponding to Bragg–Williams' and Bethe's approximations respectively. In the case of nearest neighbour systems the latter equation is derived from a variational principle, which corresponds to the maximum condition of the partition function per interaction bond expressed in terms of the distribution function. According to the author's formulation Bethe's method of internal field and Fowler–Guggenheim's quasi-chemical method are derived from the same fundamental equation. This fact helps a clear understanding of the equivalence of these two points of view, although this equivalence is demonstrated by Fowler–Guggenheim by use of the grand canonical ensemble. It is further noted that from the variational formula used the extension of the variation method of Kramers–Wannier to the three-dimensional lattices can be attained. Thus, Kramers–Wannier's approximation proves to be only a metamorphosis of Bethe's approximation. A.

530.162 : 530.145.6

8689. The quantum-mechanical partition function. H. S. Green. *J. Chem. Phys.*, **20**, 1274–81 (*Aug.*, 1952).

An exact evaluation is attempted of the quantum-mechanical partition function for an assembly of similar particles with central interaction. Quantum-mechanical analogues of the classical cluster integrals are derived and evaluated as far as required to determine the virial coefficients. It is shown that the results are particularly well adapted for computation at very low temperatures. A.

530.162 : 536.7

8690. Markoff random processes and the statistical mechanics of time-dependent phenomena. M. S. GREEN. *J. Chem. Phys.*, **20**, 1281–95 (*Aug.*, 1952).

Two principles of a statistical mechanics of time-dependent phenomena are proposed and argued for. The first states that the proper mathematical object to describe the physical situation is the stationary random process specified by the ensemble of time series $a_i(X_t)i = 1 \ldots s$ and the distribution $\rho(X)$. The set phase functions $a_i(X)i = 1 \ldots s$ represent the set of grossly observable features of the system. X_t is the image of the phase X after time t. $\rho(X)$ is a stationary distribution. The second principle is concerned with the very common case in which the phenomenological equations are of the first order in time and states that in this case the random process in question is a Markoff process. A Fokker–Planck equation is derived for the process, and an entropy is defined and is shown always to increase. Phenomenological equations are derived as a first approximation to the Markoff process. These involve a certain matrix ξ_{ij} which is shown to satisfy symmetry relations which are a generalization of Onsager's. The theory is applied to the uniformization of the direction of momentum of a particle on a two-dimensional torus subject to a small perturbing potential. A.

530.17

8691. Criteria of integral similtude. V. M. BREĬTMAN. *Zh. Tekh. Fiz.*, **22**, 625–34 (*No.* 4, 1952) *In Russian.*

The investigation of the classical theorems of similitude shows that their application is conditional upon the following propositions: (*a*) the phenomenon must be represented mathematically by explicit finite equations or by one differential equation with uniqueness conditions; (*b*) finite functions of finite variables occurring in the differential equations are independent of the variables occurring in the differentials, or depend on them in an explicit analytical form; the independent variables occurring in certain differentials are independent of those occurring in other differentials, or depend on these in an explicit analytical form; (*c*) in the similar physical phenomena investigated all the quantities of the initial homologous physical characteristics occurring in the representative equation of the process are proportional between themselves. Condition (*b*) was never demonstrated nor clearly expressed, but only implied, whilst (*c*) was uncritically adopted as the only possible condition, which led to an exaggerated generality of the similitude theorems used. The author shows that in the most general case condition (*c*) may be satisfied only by systems of specially composed physical characteristics, each of which may itself be a function of several original physical characteristics of the phenomenon. It is, however, possible that the original characteristics of the phenomenon do not yield a suitable system to satisfy condition (*c*). The systematic investigation of the integral similitude shows that integral equations are more suitable as a representation of phenomena to be treated by similitude than differential equations. B. F. KRAUS

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.224.4

8692. Instability of bellows subjected to internal pressure. J. A. HARINGX. *Philips Res. Rep.*, **7**, 189–96 (*June*, 1952).

Like thin-walled cylinders [see Abstr. 6303 (1952)] bellows may also become unstable when loaded by internal pressure. The critical value of this pressure, which in accordance with Euler's well-known formula is governed by the rigidity of the bellows with respect to bending, has been computed only for rectangularly shaped corrugations, and has been checked experimentally. A.

531.259.2

8693. Thermal stresses in axially symmetric shells with axially symmetric temperature distribution. H. PARKUS. *S.B. Öst. Akad. Wiss. IIa*, **160**, 1–13 (*No.* 1–5, 1951) *In German.*

The equations of equilibrium are written down, allowing for temperature and thickness variations over the surface, and a temperature gradient through the thickness, of an elastic shell. These are reduced to two second-order differential equations for the transverse force and angular displacement, regarded as functions of the angle between the normal to the mean surface and the axis of symmetry. The equations are solved in the cases of spherical, conical and cylindrical shells of constant thickness. J. G. OLDROYD

531.259.2

8694. Stress strain relations in the theory of thin elastic shells. E. REISSNER. *J. Math. Phys.*, **31**, 109–19 (*July*, 1952).

A discussion of the correction terms which must be retained, in the equations relating strains in a shell with stress resultants and couples, when the two classical assumptions (1) that the thickness is negligible compared with the minimum radius of curvature of the middle surface, and (2) the normals to the undeformed middle surface become normals to the deformed surface, are abandoned. Axially symmetric deformations of shells of revolution are considered in detail. J. G. OLDROYD

531.5 : 538.1

8695. On a relationship between gravitation and magnetism. T. NEUGEBAUER. *Acta Phys. Hungarica*, **1**, 151–65 (*No.* 1, 1951) *In German.*

It is shown that in closely packed matter (solids or liquids) the differential effect of the gravitational field on the core and on the outer electrons of an atom will induce a small polarization electric field. This polarization field will have the consequence of slightly displacing the core with respect to the outer electrons; and if the body is rotating, a net magnetic moment will result. On the assumption that in each spherical shell there is equality between the electric and the gravitational fields ($Mg = neE$; M is the mass of the atom, g the value of gravity, n the number of the outer electrons, e the electronic charge and E the electric field) and between the electric and gravitational potential energies ($\frac{1}{2}\alpha E^2 = \frac{1}{2}Mgl$; α is the polarizability of the core and l is the displacement of the outer electrons relative to this core). MATHEMATICAL REVIEWS

MECHANICAL MEASUREMENTS 531.7

531.714.2 : 536.423.1

8696. An automatic surface follower for measuring the rate of evaporation of molten metals undergoing vacuum distillation. M. J. Spendlove and H. W. St Clair. *Rev. Sci. Instrum.*, **23**, 471–5 (*Sept.*, 1952).

The automatic surface follower was developed to measure continuously the rate of evaporation of molten zinc at low pressure and to measure temperature gradients near the evaporating surface. The follower consists of a motor driven electrode that moves downward continuously until it contacts the metal surface and actuates a relay which stops the driving mechanism. Evaporation of metals lowers the surface levels and breaks contact with the electrode thus causing the electrode to follow the level as evaporation proceeds. A record of the level displacement is recorded on a strip-chart potentiometer as a voltage, proportional to the movement of the electrode from which the rate of evaporation can be derived as a continuous function. A thermocouple mounted on an auxiliary carriage which can be moved independently of the electrode may also be used to explore the temperature distribution above or below the surface, while the electrode automatically establishes the location of the surface as a reference point. A.

531.717 : 537.531 : 535.343

8697. X-ray thickness measurement of galvanized layers using a counter-tube diffraction-spectrometer. V. Gerold. *Z. angew. Phys.*, **4**, 247–54 (*No.* 7, 1952) *In German.*

Several known methods are reviewed, mostly depending on measurement of absorption in the layer. A new method is described in which the excitation of the characteristic radiation of the layer by CuK_α incident radiation is used. By combining two methods the thicknesses of two superimposed layers can be measured simultaneously, e.g. Cr 0–1μ thick on Ni 4–25μ thick. The construction of the spectrometer is described. A. R. Stokes

531.717.1 : 539.234 : 539.16.08

8698. A tracer method for the thickness measurement of thin Bi films. J. J. Antal and A. H. Weber. *Rev. Sci. Instrum.*, **23**, 424–6 (*Aug.*, 1952).

The use of radioactive Bi^{210} as a tracer in thin Bi films prepared by evaporation in a vacuum has resulted in a simple and direct method for the measurement of film thickness in the range 1–300 Å. The radioactivity of a standard, prepared by evaporating a weighable amount of active Bi on a piece of glass, is compared to that of a specimen of unknown thickness. For films 200 Å or less in thickness, the ratio of counting rates of the "unknown" and standard yields the mass of Bi on the unknown which, together with the film area (measured with a planimeter) and the density of Bi, yields the average Bi film thickness. Two levels of activity occurring in the standards were assigned after an electron diffraction study to a difference in structure of the Bi films. The method is accurate for extremely thin films (probable error is less than 4% if counting statistics are carried to a probable error of 3%), simple procedures and calculations are used, calibration is continuous, and the specimen is not altered in any way. A.

531.719.1

8699. The effective radius of curvature of knife edges. G. F. Hodsman and F. A. Chappell. *J. Sci. Instrum.*, **29**, 330–2 (*Oct.*, 1952).

Knife edges used as bearings in fine chemical balances exhibit a finite radius of curvature. This radius affects the precision of the instrument and its magnitude is of interest to the balance designer. A technique is described for the measurement of this "effective" radius. Some results are given for brass and agate knife edges, values in the range 1–3 μ being obtained in the latter case. A.

523.72

8700. The determination of the energy flux of the sun's extraterrestrial radiation. M. Nicolet. *Arch. Meteorol. Geophys. Bioklimatol. B*, **3**, 209–19 (1951) *In French.*

The problem of the spectral density of the energy flux of the extra-terrestrial solar radiation has been examined anew in relation to the problem of the solar constant. Based on the special densities of the energy flux of the total radiation of the photosphere, the extra-terrestrial spectral distribution of the solar radiation has been determined from 0·2 μ to 10 μ. These new values ought to be employed in actinometric investigations. The use of these results shows in which manner the different ultra-violet and infra-red corrections for the radiation which cannot be observed, have been introduced for determining the solar constant. In addition, an explanation is given of the latest actinometric results. It results that the solar constant in the new scale of the Smithsonian Institution (1932–1934–1948) must be 1·98 cal $cm^{-2}min^{-1}$. Nevertheless, an error which can exceed $\pm 5\%$ must be admitted as long as new absolute measurements of the spectral densities or of the total extra-terrestrial flux have not been carried out. A.

531.767 : 778.3

8701. The measurement of velocities for solid-fluid flow in a pipe. C. Jones and G. Hermges. *Brit. J. Appl. Phys.*, **3**, 283–4 (*Sept.*, 1952).

When a stream of particles is conveyed by air or water in a glass pipe two photographs of a portion of the stream are superimposed on the same photographic negative. The pictures are taken by the light from a pair of discharge lamps, the time interval between the flashes being variable and measured by a rotating disk. A more satisfactory light source is a high speed stroboscope, the interval between flashes being predetermined by a setting of a multivibrator. The velocity of a particle is obtained from its displacement measured on the photograph. The method is illustrated by its application to the movement of gravel by air and coal by water. A.

531.768

8702. A pre-loaded spring accelerometer for shock and impact measurements. D. E. Hudson and O. D. Terrell. *Proc. Soc. Exp. Stress Anal.*, **9**, 1–10 (*No.* 1, 1951).

An accelerometer of the pre-loaded spring type is described, into which accelerations from 25 g to 1300 g can be recorded *v.* time. The mechanical

ength of the equipment is such that the entire cording system can be subjected to the shock hich is being measured. The method of recording volves only the indication of the making or breakg of an electrical contact which activates a spring-iven neon tube camera recorder.

INDEX AERONAUTICUS

531.768

703. Unbonded wire resistance strain gauge celerometers. J. R. BRISTOW AND F. G. ELLAMES. *Sci. Instrum.*, **29**, 288–9 (*Sept.*, 1952).

Accelerometers of the damped inertia type are escribed, in which the main elastic restraint of he moving mass is provided by unbonded free wire esistance strain gauges; change of resistance of these auges is then a measure of the accelerations experinced by the instrument. The accelerometer output recorded with the normal type of dynamic strain ecording equipment used with bonded wire resistnce strain gauges. Two accelerometers are decribed, having natural frequencies of 165 c/s and 15 c/s with outputs of 0·30 mV/V/g and 0·081 nV/V/g up to ±3 g and ±13 g respectively; both are luid damped to 0·6–0·7 damping ratio. A.

531.768 : 537.543

8704. Recent developments in the Ramberg vacuum ube accelerometer. S. LEVY. *Proc. Soc. Exp. Stress Anal.*, **9**, 151–8 (*No.* 1, 1951).

Displacement of two cantilever-supported anodes varies plate resistances oppositely in a special electron tube, which is thus acceleration-responsive well below the natural frequency of the plates. The present model features improved stability and drift, obtained principally by decreasing anode-support stiffness to ¼, and by closer attention to ageing and gettering. With natural frequency of 160 c/s and 16·7 V anode supply, average fractional change in plate resistance per g-acceleration unit is about 0·1. Maximum 4 hr drift is 0·04 g, and range is 10 to 20 g.

APPLIED MECHANICS REVIEWS

531.78

8705. A recording stress relaxometer. J. R. MCLOUGHLIN. *Rev. Sci. Instrum.*, **23**, 459–62 (*Sept.*, 1952).

This instrument measures the lateral deflection of bowed steel strips in the load-measuring element. The deflection is measured electrically by means of a linear differential transformer coupled to a recording potentiometer through an a.c. electronic voltmeter. The recording stress relaxometer maintains the strain in the sample constant to 0·001 in during complete relaxation of the stress. It can be used on materials with moduli ranging between 10^7 and 10^{11} dynes/cm.^{2} It is also suitable for use as a simple tensile tester. A.

531.787

8706. A gauge for indicating pressure transients in a combustion chamber. H. D. WARSHAW. *Rev. Sci. Instrum.*, **23**, 493–6 (*Sept.*, 1952).

A gauge that is linearly responsive to pressure changes in the order of 400 lb/in^2 per μsec with a useful range of 0–16 000 lb/in^2 is described. The gauge is designed for mounting in the wall of a combustion chamber and is small enough to use in the barrel of a calibre 0·50 weapon. A bonded wire strain gauge in a conventional ballast circuit converts the pressure function into an electrical signal that is displayed on the screen of a cathode-ray oscilloscope. This equipment has been used extensively to measure gun muzzle pressures. A.

531.787.3 : 532.62

8707. Automatic recording of the pressure-area, pressure-time, and area-time characteristics of monomolecular films. P. A. ANDERSON AND A. A. EVETT. *Rev. Sci. Instrum.*, **23**, 485–8 (*Sept.*, 1952).

A null-deflection film balance which retains the sensitivity and range of the manually operated Langmuir–Adam balance but which is capable of following rate processes continuously is described. It provides automatic plotting of (1) film pressure as a function of molecular area during continuous compression or expansion, (2) film pressure as a function of time at constant film area, and (3) film area as a function of time at constant film pressure. The design utilizes commercially available components. Recording is done with a pen-and-ink recorder of standard type, and the curves are visible in their entirety during an experiment. The co-ordinates are adjustable to make the chart direct reading in $F(A)$, $F(t)$ or $A(t)$ to any convenient scale or degree of scale expansion. Continuous use for 18 months has shown the instrument to be consistently reliable and convenient. A.

531.787.6 : 537.32

8708. Thermocouple micromanometer. Theoretical and experimental study. D. DEGRAS. *Vide*, **7**, 1153–71 (*March*, 1952) *In French.*

The construction of the commercial instrument "Pyrovac type 20" of the Compagnie Générale de Radiologie is briefly described and a detailed mathematical derivation of the action is given. Expressions for the sensitivity are obtained and the influence of the external temperature, the electrical circuit and the nature of the gas on the sensitivity are considered. The importance of, and the factors affecting, the ageing of the couple are discussed. Numerical values of the various parameters relating to the commercial instrument are given. S. WEINTROUB

MECHANICS OF FLUIDS 532

532.123 : 536.423.15

8709. Possible explanation of Briggs' limiting negative pressure data. V. J. BERRY AND E. W. HOUGH. Letter in *J. Appl. Phys.*, **23**, 931 (*Aug.*, 1952).

It is suggested that surface effects at the liquid glass interface might account for the observed decrease in limiting pressures near the melting point. See Abstr. 6768 (1951). T. C. TOYE

532.13

8710. The temperature dependence of the viscosity of liquids. F. GUTMANN AND L. M. SIMMONS. *J. Appl. Phys.*, **23**, 977–8 (*Sept.*, 1952).

The equation $\log \eta = A + B/(T + C)$ is obtained as a simple modification of Andrade's viscosity equation by treating the activation energy as a

function of temperature, A, B and C being free parameters. This is shown statistically to express adequately the temperature dependence of viscosity over substantial ranges of temperature for all the liquids examined, viz. n-heptane; n-nonane; n-undecane; n-tridecane; n-heptadecane; benzene; viscous mineral oil; ethanol; 1,2-dibromopropane; H_2O; Hg; molten Ga; K; Na; $NaNO_3$; AgBr; $PbCl_2$; Br; 98–100% H_2SO_4. A.

532.13 : 536.2

8711. Heat conductivity-viscosity relationship for liquids at the freezing point of water. S. R. MOHANTY. Letter in *Curr. Sci.*, **21**, 8 (*Jan.*, 1952).

A previously proposed relation [Abstr. 8543 (1951)] is examined for water at the freezing point. Allowing for the association factor reasonable agreement with the theoretical value of Mk/η is obtained (M is molecular weight, k thermal conductivity, η viscosity). F. E. HOARE

532.13 : 541.182.6

8712. A treatment of the viscosity of concentrated suspensions. R. SIMHA. *J. Appl. Phys.*, **23**, 1020–4 (*Sept.*, 1952).

In current theories of the concentration dependence the solute molecules are treated as point centres of disturbance. The finite size that produces a shielding of two interacting particles in the presence of intervening ones reduces the interaction calculated in the point approximation and thus reduces the discrepancy between experiment and theory. An approximate treatment for a spherical solute based on the cage model, and hence more adequate at high concentrations, is presented. It operates with a spherical enclosure around a central particle. The position of this shell reflects the relative extent to which particles beyond nearest neighbours can hydrodynamically interact with the central molecule. Thus, a parameter f appears in the theory which increases slowly with concentration and approaches a limit corresponding to the coincidence of the shell with the wall of the nearest neighbour cage at high concentrations. In the framework of the present theory, f must be regarded as a semi-empirical quantity. The hydrodynamic problem can be handled rigorously. The relative viscosity calculated is in satisfactory agreement over a range of concentrations with empirical expressions successfully applied to pertinent systems. The initial value of f derived from the observed coefficient of the quadratic term is also reasonable. A.

532.133

8713. Viscosities of some lower aliphatic alcohols at constant volume. A. JOBLING AND A. S. C. LAWRENCE. *J. Chem. Phys.*, **20**, 1296–8 (*Aug.*, 1952).

From an analysis of all the published experimental data for methyl, ethyl, *n*-propyl, *iso*butyl and *n*-octadecyl alcohols, it is shown that, even for these compounds, at constant volume $\log \eta$ is a rectilinear function of $1/T$ and the general pattern of behaviour is similar to that described previously. $\mathscr{E}_v$, the energy of activation of viscous flow at constant volume, is plotted as a function of volume, and the curve for ethyl alcohol shows an apparently anomalous minimum. A.

532.137

8714. A new method of high temperature viscometry by the method of oscillating hollow bodies. A. KNAPPWOST. *Z. phys. Chem.*, **200**, 81–9 (*July*, 1952) *In German.*

The author shows how his previous (1948) two-constant formula can be converted to a single constant one. See also Abstr. 109 (1951). T. C. TOYE

532.15 : 541.182.6

8715. Sedimentation behaviour of flexible chain molecules: polyisobutylene. L. MANDELKERN, W. R. KRIGBAUM, H. A. SCHERAGA AND P. J. FLORY. *J. Chem. Phys.*, **20**, 1392–7 (*Sept.*, 1952).

The sedimentation constants s_0 at infinite dilution and the intrinsic viscosities $[\eta]$ of five fractions of polyisobutylene have been determined in cyclohexane, a good solvent. Their osmotic molecular weights ranged from $3{\cdot}1\times10^4$ to $1{\cdot}4\times10^6$. Under the assumption that the effective hydrodynamic radii vary as the average linear dimensions of the molecule, $f_0/\eta_0 = P(\langle r^2\rangle)^{\frac{1}{2}}$ and $[\eta] = \Phi(\langle r^2\rangle)^{\frac{3}{2}}/M$, where f_0 is the frictional coefficient, η_0 is the viscosity of the solvent, $\langle r^2\rangle$ is the mean-square end-to-end distance of the molecule, and P and Φ are constants. In confirmation, $s_0[\eta]^{\frac{1}{3}}/M^{\frac{2}{3}}$ is constant throughout the molecular weight range investigated. Furthermore, $\Phi^{\frac{1}{3}}P^{-1} = 2{\cdot}5\times10^6$ The close agreement of this quantity with values for four other systems reported in the literature indicates that P, like Φ, is a universal constant for flexible chain molecules. It follows also that the observed proportionality of s_0 (or of M/f_0) to $M^{0{\cdot}42}$ instead of to $M^{\frac{1}{2}}$ occurs because of intramolecular interactions which cause the molecule in solution to be expanded by a factor α which increases with molecular weight. The above theory accounts for both the sedimentation and intrinsic viscosity behaviour of flexible chain molecules in a satisfactory manner. Neither the Kirkwood–Riseman nor the Debye–Bueche theories succeeds in doing so. A.

532.51 : 518.61

8716. Relaxation technique for three-dimensional flow net. C.-H. CHIEN. *Trans Amer. Geophys. Un.*, **33**, 123–5 (*Feb.*, 1952).

532.511

8717. Exact solutions of the Stokes–Navier equations for incompressible fluids with modified boundary conditions. J. ACKERET. *Z. angew. Math. Phys.*, **3**, 259–71 (*No.* 4, 1952) *In German.*

As Stokes pointed out, there exist exact solutions of the hydrodynamic equations if the boundary conditions are modified. If it can be arranged that the "solid" boundaries are actually moving with the fluid velocity, then really simple solutions are obtained. Several examples are worked out. As turbulence is unlikely to occur under these conditions the power to move bodies in a viscous fluid at high Reynolds numbers would become extremely low. It seems that even a partial fulfilment of these changed conditions would be of practical interest. A.

532.512 : 530.162 : 536.7

8718. On the hydrodynamics of degenerating Bose–Einstein gases. S. NAKAJIMA. *Progr. Theor. Phys.*, **6**, 980–9 (*Nov.–Dec.*, 1951).

The hydrodynamic equations of the degenerating

ideal Bose–Einstein gas are derived, assuming that the distribution function of gas atoms has a singularity of δ-type in momentum space:

$$f = N_s\delta(p - P_s) + f_n.$$

For f_n, a particular approximate solution is proposed, in which the mean momentum of the normal atoms is different from the momentum of the condensed atoms, P_s. The resulting thermohydrodynamic equations are very similar to those of the two fluid model of liquid helium II. In both cases, for instance, the two component fluids exert the frictional forces on each other. Nevertheless the degenerating ideal Bose–Einstein gas does not exhibit such peculiar properties as second sound, fountain pressure, etc., because of the vanishing chemical potential in this case. A.

532.517 : 538.69

8719. Experiments on non-laminar flow of mercury in presence of a magnetic field. B. LEHNERT. *Tellus*, **4**, 63–7 (*Feb.*, 1952).

Two examples are given of non-laminar motion in an electrically conducting liquid in the presence of an external magnetic field. A.

532.543

8720. Evaluation of the critical regime in stratified flow. A. CRAYA. *Trans Amer. Geophys. Un.*, **32**, 891–7 (*Dec.*, 1951).

Consideration of the momentum principle and of the energy principle permits the formulation of two integral expressions for the cross-section of a stratified current, the value of which can only decrease. These integrals nevertheless have a minimum value which is attained for a certain thickness of the current and for a certain velocity distribution, which by definition represent the critical regime. Critical regimes obtained by the two foregoing principles are not identical, though very nearly so. Concerning the shape of the critical distribution of velocity, the following cases are distinguished: (*a*) for a surface current without any restriction on the displacement of the topmost layer, the velocity increases from zero at the interface to a maximum at the free surface; (*b*) for a surface current of which the topmost streamline is restricted to a condition like constancy of elevation, there is a maximum velocity some distance under the free surface. A.

532.58 : 532.593

8721. Bottom pressure fluctuations due to standing waves in a deep, two-layer ocean. H. A. KIERSTEAD. *Trans Amer. Geophys. Un.*, **33**, 390–6 (*June*, 1952).

The pressure fluctuation in a deep ocean, due to short-period surface waves, is calculated by means of a simple physical model. It is shown, as was pointed out earlier by Longuet-Higgins, that the pressure under a standing wave varies at twice the frequency of the wave and with an amplitude proportional to the square of the wave amplitude, and inversely proportional to the wavelength, but that the pressure under a progressive wave is constant. A similar calculation of the pressure fluctuation under a standing internal wave gives similar results, but the amplitude is diminished by the factor $(\Delta\rho/\rho)$. Numerical calculations, using typical wave amplitudes, show that pressure fluctuations of about 30 cm may occasionally be expected under 6-sec surface waves, but that internal waves, because of their large wavelengths, will have little effect on the pressure in the deep ocean. A.

532.582.3 : 532.59

8722. The forces exerted by waves on objects. M. P. O'BRIEN AND J. R. MORISON. *Trans Amer. Geophys. Un.*, **33**, 32–8 (*Feb.*, 1952).

A theory is developed and experimental verification is presented for the force exerted by surface waves on a submerged spherical object. The object was small compared to the wavelength, and its position was near the bottom. The components of force consist of form drag and inertia forces. A.

532.582.7 : 532.517.4

8723. Turbulent diffusion and erosion. R. W. DAVIES. *J. Appl. Phys.*, **23**, 941–8 (*Sept.*, 1952).

A new theory of turbulent diffusion is developed so as to describe the dynamics of particulate matter in fluid suspensions. In order that the statistical description be consistent with force equation dynamics of sedimentation, a new diffusion equation is derived from the postulates of a past-future stochastic process. A steady state suspension of particles in a turbulent stream is treated like an atmosphere. Dimensional arguments are used to retain the most relevant physical entities in a linear theory. It is shown that the bed load and mid-stream suspension of a muddy stream cannot be considered separately. Some experiments are discussed in this connection. A qualitative theory of sand rippling is explained in terms of the instability of a flat sandy bottom under certain turbulence conditions. A singular perturbation method is employed to obtain an asymptotic expansion of the solution of the equilibrium equation. Assumptions are discussed and criticized. The advantage of the theory is that all statistical coefficients are averages of familiar dynamical quantities. A.

532.595

8724. Propagation of elastic waves in a cylindrical bore containing a fluid. M. A. BIOT. *J. Appl. Phys.*, **23**, 997–1005 (*Sept.*, 1952).

Deals with the propagation of unattenuated elastic waves in a cylindrical bore through an elastic material of infinite extent filled with a fluid. The phase and group velocity dispersion curves are plotted for axial symmetric waves in the coupled fluid-solid system. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 530.162

8725. Quantum hydrodynamics. R. EISENSCHITZ. Letter in *Phil. Mag.*, **43**, 804–6 (*July*, 1952).

Kirkwood's classical theory of transport processes is developed in terms of quantum mechanics. See also Abstr. 9297 (1951). T. C. TOYE

532.7 : 533.7

8726. Interior pressure in gases and liquids. D. M. MILOSAVLJEVIĆ AND L. MILOSAVLJEVIĆ. *Bull. Soc. Chim. Belgrade*, **15**, 69–80 (1950).

For the expression for the interior p in the Van der

Waals equation a/v^2 the author substitutes the expression $P_i = (v_K/v^2)e^{v_K/v}$, where v_K denotes the vol. of the liquid phase at the triple point, and k a constant. From the expression the value for L has been calculated. $L = k(e^{v'_k/v'} - e^{v''_k/v''})$, where v' denotes the sp. vol. in the liquid and v'' the sp. vol. in the gaseous phase at the b.pt. The value for k is verified on data for CO_2, H_2O, C_6H_6, A, H_2, and Hg. The agreement for CO_2 is very good, but there is a slight decrease in the value for k for H_2O and C_6H_6 and a slight increase for those of A and H_2. A low max. is shown by the values for Hg. BRITISH ABSTRACTS

532.74 : 539.155.2

8727. Ionic hydration: an isotopic fractionation technique. H. M. FEDER AND H. TAUBE. Letter in *J. Chem. Phys.*, **20**, 1335–6 (*Aug.*, 1952).

Ions may bring about appreciable fractionation of the O isotopes in the H_2O in which they are dissolved. The connection between this effect and ionic hydration is considered. If an ion is hydrated in the sense that characteristic internal vibrations of the hydrated ion can be detected, the group vibrations of bound isotopic H_2O molecules will differ in their zero-point vibrational energy levels. The effect of these differences is to decrease the activity of heavier species with respect to light ones. In order to discover the effect of dissolving $Mg(ClO_4)_2$, HCl, LiCl, $AgClO_4$, $NaClO_4$, $Cr(ClO_4)_3$, $[Coen_3]Cl_3$, and NaI in H_2O on the isotopic composition of the H_2O, solutions of these substances were allowed to come into equilibrium with CO_2, and the isotopic composition of the resulting gas was determined. Exchange takes place as follows: $H_2O^{18} + CO_2{}^{16} = H_2O^{16} + CO^{16}O^{18}$. The results indicate that the hydration numbers of the ions concerned are constant up to fairly high concentrations. A. J. MEE

532.77

8728. Chemical potentials of some alkali salts in aqueous solutions and the evaluation of chemical potentials from vapour pressure measurements. H. DIETER AND H. GEHLEN. *Z. phys. Chem.*, **200**, 41–52 (*July*, 1952) *In German.*

Suggests 3 new, simple and exact methods (algorithmic, graphical and analytical) for the evaluation of the integral

$$I = \int_{m_1}^{m_2} \frac{\frac{d(-\log \rho)}{dm}}{m} dm$$

contained in the formula relating the chemical potentials of dissolved substances and the dependence of the vapour pressure of the solution upon concentration. The application of these methods is illustrated on aqueous solutions of LiCl, $LiNO_3$, NaCl, NaBr, KCl and KI. F. LACHMAN

532.77

8729. Influence of the solvent on rates of ionization, entropies, and heats of activation. R. G. PEARSON. *J. Chem. Phys.*, **20**, 1478–80 (*Sept.*, 1952).

A breakdown of the rates of reactions in which ions are formed from neutral molecules into heats and entropies of activation reveals the following regularities with change in solvent: the heats of activation do not change greatly and are more frequently larger in polar solvents than in non-polar ones; the entropies of activation are always negative and become more negative as the polarity of the solvent decreases. An explanation is given in terms of solvent molecules "frozen" around the incipient ions of the activated complex. Non-polar solvents suffer a greater loss in entropy in such "freezing" than polar solvents. An electrostatic calculation is given which is satisfactory for all solvents whose molecules contain a permanent dipole moment, but which must break down for non-polar solvents. A.

532.77 : 541.135

On strong electrolytes in solutions. *See Abstr.* 9116

MECHANICS OF GASES 533

533.12

8730. The limiting densities of vapours. F. L. CASADO, D. S. MASSIE AND R. WHYTLAW-GRAY. *Proc. Roy. Soc. A*, **214**, 466–70 (*Oct.* 9, 1952).

By means of a method already described [Abstr. 6777 (1951)] the densities at a series of low pressures of the unsaturated vapours of ethyl ether, carbon tetrachloride, carbon disulphide, perfluoro-methyl-*cyclo*hexane and acetone have been determined at 22°C. The deviations from ideality with pressure of all these vapours were, with the exception of acetone, found to be strictly linear within the limits of experimental error, and the molecular weights deduced from the limiting densities showed a close agreement with standard values. It is concluded that the principle of limiting densities can be extended to the determination of the exact molecular weights of the vapours of normal liquids. A.

533.15 : 536.2

8731. An electrical analogue for the study of diffusion processes with internal gains or losses. C. H. M. VAN BAVEL AND A. W. WALTNER. *Trans Amer. Geophys. Un.*, **32**, 885–90 (*Dec.*, 1951).

By placing a fairly large number of electrodes in a layer of liquid and with proper boundary conditions an electrical analogue may be constructed that is representative for diffusion of mass or energy through a medium with internal gains or losses. It is shown that the results obtained with such an electrical analogue are in agreement with those exacted by a theoretical treatment of such problems for diffusion in one dimension, this being applicable to gaseous diffusion in soils. It is also shown that this method may be used to obtain information on temperature distribution in cases of heat transfer where heat is being generated or lost in the medium through which it diffuses by conduction. A specific example of such an instance has been examined and numerical values are given. A.

533.5

8732. New trends in vacuum research based on ionisation phenomena. A. VON ENGEL. *Vacuum*, **1**, 257–65 (*Oct.*, 1951).

The range of pressure measurement of the McLeod gauge and the Philips ionization gauge has been

extended recently. For the measurement of ultra-high vacua only the thermionic ionization gauge can be used, but in such a form that the effect of soft X-rays is reduced considerably. The ionization gauge also acts as an ionization pump giving vacua of about 10^{-11} mm Hg. A method of producing very pure He gas from liquid He II is described. A.

533.5

8733. Knudsen gauges. W. STECKELMACHER. *Vacuum*, **1**, 266–82 (*Oct.*, 1951).

A brief review of the development and applications of the Knudsen gauge is followed by a detailed description of improved forms of metal and glass gauges. Their performance with respect to factors such as outgassing, methods of suspension, extension of range by electromagnetic compensation, and damping are discussed. The theory of the absolute manometer is reviewed. In particular, the fundamental assumptions concerning accommodation coefficient, the edge effect due to large heater-to-vane distance, and vane temperature, in the low pressure (Knudsen) region are discussed. A theory is developed to give a correction factor for a rectangular vane and heater valid for any dimensions and distance. It is shown that under certain conditions calibration is independent of the temperature of the vane. A.

533.5

8734. Ho coefficient—correction and comment. J. POLLARD; D. LATHAM. Letters in *J. Sci. Instrum.*, **29**, 269 (*Aug.*, 1952).

The use of the Ho coefficient [ratio of vol. pumped per unit time to theoretical speed of diffusion; Abstr. 823 (1952)] as an index of the efficiency of vapour pumps is questioned, with examples in which the coefficient is misleading. Complete assessment of diffusion pumps cannot be obtained from any single coefficient, as other pump characteristics and also operational convenience must be considered.

G. WITTENBERG

533.6.011.6 : 536.244

8735. Heat transfer from the surface of the solid body in the turbulent air stream. T. SOEYA. *J. Fac. Sci. Hokkaido Univ., II*, **3**, 305–20 (*Feb.*, 1950).

The problem of cooling was experimentally investigated. The data was analysed from the point of view of the statistical theory of turbulence, and a simple relation between the heat transfer coefficient and the statistical factor of turbulence was obtained.

MOLECULAR THEORY OF GASES 533.7

533.75

8736. On equation of state of real gases. M. DUTTA. *Proc. Nat. Inst. Sci. India*, **18**, 81–91 (*March–April*, 1952).

In the first part, the Planck–Saha–Bose equation of state, which will be taken as basis for deducing more accurate equations of state in later development, has been obtained by the statistical method, developed by the author in some of his previous papers [Abstr. 4181 (1952)]. In the second part, on taking the overlapping of the Deckungsphären into consideration by the above method after suitable modifications, the usually accepted value of the second virial coefficient of the equation of state has been obtained. After this, the relation (or better equivalence) between this method and that of Boltzmann has been discussed, and some of the unsatisfactory features, common in both the methods, have been pointed out. Finally a modified method, which is free from the above-mentioned unsatisfactory features to some extent, has been suggested, and a value of the second virial coefficient obtained by rough calculations from this method is, of course, found to deviate from the accepted value by about 30%. But the value obtained here appears to be more reliable, and is expected to be verified when more accurately designed experiments are performed. A.

VIBRATIONS . ACOUSTICS 534

534.121

8737. Axially symmetric vibrations of a finite isotropic disk. I. R. R. AGGARWAL. *J. Acoust. Soc. Amer.*, **24**, 463–7 (*Sept.*, 1952).

Some frequencies for the symmetrical normal nodes of a finite, isotropic disk are calculated by satisfying the boundary conditions exactly at the flat surfaces and approximately at the curved surface. It is found that two sets of frequencies occur for each vibration pattern. One set approaches the odd order thickness compressional frequencies, whereas the other approaches the even order thickness shear frequencies, as the radius of the disk increases indefinitely. As a test of the validity of the approximations, the maximum residual stresses at the curved surface are compared with the compressional component of the stress at the centre of the disk. A.

534.131.2 : 532.59

8738. Waves in liquid-filled cylinders. R. D. FAY. *J. Acoust. Soc. Amer.*, **24**, 459–62 (*Sept.*, 1952).

If a system comprising a water column bounded by a steel cylindrical shell is driven at a fixed frequency, the pressure amplitude has been found to vary along the axis in a complex manner. On the hypothesis that this phenomenon results from the excitation of two or more modes of vibration having different speeds of phase propagation, an investigation has been made of waves in liquid-filled cylindrical shells. It is shown that, in addition to the modes associated with boundaries of high impedance, there is also a possible mode associated with each type of free wave in the shell. The phase velocities of several symmetrical free waves are calculated by an extension of the method employed by Love for solid cylinders. A comparison with measurements appears to confirm the hypothesis. A.

534.213

8739. Acoustic radiation pressure of plane-compressional waves at oblique incidence. F. E. BORGNIS. *J. Acoust. Soc. Amer.*, **24**, 468–9 (*Sept.*, 1952).

The forces due to acoustic radiation in a beam of finite cross-section in a nonviscous medium striking a

plane reflector at oblique incidence are derived from simple mechanical considerations. The formulae are applied to a wedge-shaped vane. For a vane, the wings of which include an angle of 90°, the force turns out to be quite independent of the coefficient of reflection at the boundary between vane and medium. A.

534.22/.23

8740. Dispersion of ultrasonic waves in ethylene. O. Nomoto, T. Ikeda and T. Kishimoto. Note in *J. Phys. Soc. Japan*, **7**, 117–18 (*Jan.–Feb.*, 1952).

The dispersion of ultrasonic waves in ethylene measured by Richards and Reid (1934) at 94 kc/s and 476 kc/s, is measured at higher frequencies by the authors, who have now completed the dispersion curve. A peak in the absorption near the middle of the dispersion region is indicated. T. C. TOYE

534.22/.23

8741. Ultrasonic velocity, dispersion, and absorption in dry, CO_2-free air. C. Ener, A. F. Gabrysh and J. C. Hubbard. *J. Acoust. Soc. Amer.*, **24**, 474–7 (*Sept.*, 1952).

The velocity, dispersion and absorption of ultrasonic waves in dry, CO_2-free air have been measured at 32°c, and at 2 and 3 Mc/s, and at pressures ranging from 0·020 to one atm. Dispersion of the velocity has been found beginning at 30 Mc/atm., increasing by 5% at 100 Mc/atm., accompanied by a large increase in absorption such that, at the higher limits of f/p reached, measurements became nearly impossible with the equipment used. The ratio $\alpha_{exp}/\alpha_{class}$ decreased from about 2·4 to 1·3 and C_v/R from 2·5 to nearly 1·5 as f/p increased. The changes in velocity, absorption and internal specific heat are interpreted as the result of the slowing of energy exchange between translational and rotational states. Assuming that relations for relaxation of translational-vibrational exchange also hold for this case, the relaxation time for translational-rotational exchange as derived from the dispersion measurements has been found to be $2{\cdot}29\times10^{-9}$ sec. This corresponds to a frequency of the midpoint of the dispersion curve of 116 Mc/atm., and to 16 as the number per molecule of collisions required for an energy exchange between translational and rotational states. Absorption results were more difficult to secure; using low frequency values a relaxation time of about 3×10^{-9} sec is indicated, giving 87 Mc/atm. as the f/p value of the midpoint of the dispersion curve, and 21 as the number of collisions required for the energy exchange. A.

534.22/.23

8742. Velocity and absorption of ultrasonics in gases. S. Petralia. *Nuovo Cim.*, **9** (*Suppl. No.* 1) 1–58 (1952) *In Italian.*

A review in which the theory of ultrasonic dispersion, the molecular heats of vibration with reference to the absorption bands, the experimental arrangements and methods together with results of measurements of the velocity and absorption in the more important gases and vapours are discussed. Comprehensive tables of values are given. 178 refs. S. WEINTROUB

534.22

8743. On a method of determining the velocity of propagation of ultrasonic waves in solid bodies. N. F. Otpushchennikov. *Zh. Eksper. Teor. Fiz.*, **22**, 436–9 (*No.* 4, 1952) *In Russian.*

The method consists of introducing a well-polished thin wedge of the solid under investigation, with an angle of taper of 1–2° and a length of up to 20 cm, between two 18 mm quartz plates acting as an ultrasonic generator and a pick-up respectively, and finding on the wedge the points of maximum sound transmission (where wedge thickness $l = n\lambda/2$). The velocity of propagation is then calculated, using Rayleigh's law, from $v = [2(l_m - l_1)/(m-1)]\nu$, where ν is the frequency, m is the number of maxima, and $l_m - l_1$ is the difference in wedge thickness between the 1st and mth maximum. An accuracy of ±10 m/sec can be achieved and the method can be used also for sound absorbing media. A. GELBTUCH

534.231

8744. On the theory of the sound of rotation. A. V. Nedospasov. *Zh. Tekh. Fiz.*, **22**, 579–84 (*No.* 4, 1952) *In Russian.*

The accuracy of Nepomnyashchiĭ's calculation (1941) of the acoustic field of a propeller is tested with the aid of a solution derived for a sphere rotating around an external fixed axis. The sphere is enclosed within a control surface, on which linear relations are assumed to hold, and within which are used the equations for an inviscid compressible fluid to obtain the boundary conditions on the control surface for solving the acoustic equation. A. GELBTUCH

534.231

8745. A new method for the visualization and measurement of ultrasonic fields. G. S. Bennett. *J. Acoust. Soc. Amer.*, **24**, 470–4 (*Sept.*, 1952).

A new method for the observation of ultrasonic field distributions is described, utilizing a starch plate in a dilute solution of iodine in a manner analogous to the use of photographic emulsions. Near-field diffraction patterns are shown as illustrative of results, which appear to be superior to those of other methods, and the advantages of the new method over previous techniques are described. A.

534.231 : 535.43

8746. On an optical method of controlling the character of acoustic field. G. P. Motulevich and I. L. Fabelinskiĭ. *Dokl. Akad. Nauk SSSR*, **81**, 787–90 (*No.* 5, 1951) *In Russian.*

The setting of acoustical interference filters, which determines their effectiveness in filtering away oblique sound waves, can be accurately controlled by investigating the intensity distribution of the first diffraction maximum of a beam of light projected across the sound waves, as a function of the direction of propagation of the sound wave. The theory of the method is briefly outlined. A. GELBTUCH

534.232

8747. Natural vibrations of rectangular quartz plates and determination of the dispersion of sound in ethyl ether. B. Özdoğan. Letter in *J. Acoust. Soc. Amer.*, **24**, 541–2 (*Sept.*, 1952).

An acoustical interferometer was used to measure the frequencies of two quartz plates vibrating in air

and to study the variation in the velocity of sound in ethyl ether vapour at 19°C over a range of frequencies of about 150–2500 kc/s and a range of pressures of 75–340 mm Hg. The results for the vapour are shown graphically and indicate a relaxation time $\tau = 6{\cdot}6\times10^{-8}$ sec at 1 atmosphere. H. J. H. STARKS

534.232

8748. On the propagation of sound from a flat pulsating radiator. A. A. KASPARYANTS. *Appl. Math. Mech.* [*Leningrad*] **15,** 445–50 (*July–Aug.*, 1951) *In Russian.*

Author considers the decay of the velocity potential of a field of sound generated by a harmonically vibrating piston in a flat infinite wall, after the piston has suddenly stopped moving. Part 2 deals with the establishment of the field during the transient state, when the piston suddenly begins vibrating. In both cases, the velocity potential in a point M at time t after the piston has stopped or begun, is given by an integral over the part of the piston lying within the sphere with radius ct and centre M.

APPLIED MECHANICS REVIEWS

534.322.3 : 534.79

8749. The loudness of bands of noise. I. POLLACK. *J. Acoust. Soc. Amer.*, **24,** 533–8 (*Sept.*, 1952).

The contribution to the loudness of noise made by various frequency bands was studied over a wide range of noise levels. Paralleling results with pure tones, the contribution of noise of the middle frequency range to loudness is greater than that of low and high frequency noise (for bands 250 to 300 mels in width). In order to produce maximal loudness with a fixed over-all sound level, it was found, in most cases, more economical to spread the noise spectrum over a wide frequency range than to concentrate the noise spectrum in a restricted range of frequencies. A.

534.39 : 536.24

8750. Flows near a heated solid body in a standing sound wave. P. N. KUBANSKIĬ. *Zh. Tekh. Fiz.*, **22,** 585–92 (*No.* 4, 1952) *In Russian.*

The "acoustic wind" around an internally heated 2·4 cm diam., 32·5 cm long brass tube was studied at sound intensities of 0·03 to 0·16 watts/cm² and frequencies of 8 to 30 kc/s. The flow pattern, visualized by projecting it on to a screen, confirms the theoretical results of Schlichting (1932). A considerable increase of the heat transfer coefficient was observed on the establishment of the acoustic field at the cylinder. The use of sound waves for increasing the rate of heat transfer in industrial processes, e.g. drying, is advocated. A. GELBTUCH

534.39 : 536.24

8751. The effect of acoustic vibrations of finite amplitude on the boundary layer. P. N. KUBANSKIĬ. *Zh. Tekh. Fiz.*, **22,** 593–601 (*No.* 4, 1952) *In Russian.*

The investigation was carried out by mounting a 2·4 cm dia. brass tube in the open section of a wind tunnel perpendicularly to the air flow and observing optically the effect of a standing sound wave, perpendicular to the flow and perpendicular or parallel to the tube, on the behaviour of the boundary layer at $Re = 2500$ and various sound intensities. Similar tests were carried out using a 1·5 cm dia. tube with $Re = 1450$ to 1775 and measuring the heat transfer from the tube. Using sound waves with mean vibration velocities exceeding the velocity of air flow, it was possible to increase the heat transfer coefficient by up to 50%. The use of sound waves for controlling the boundary layer, and thus the processes depending on its condition, e.g. the heat transfer, is considered feasible. A. GELBTUCH

534.7 : 612.85

Physiological acoustics. Hearing. *See Abstr.* 9261–5

534.78

8752. The perception of speech sounds by deafened persons. H. FLETCHER. *J. Acoust. Soc. Amer.*, **24,** 490–7 (*Sept.*, 1952).

In a previous paper [Abstr. 5651 (1950)] a method was described for measuring experimentally and also for calculating the interpretation aspect of the perception of speech. The listeners were considered to have normal hearing. In the present paper the same principles are applied to persons having abnormal hearing. A.

534.78

8753. On the effect of frequency and amplitude distortion on the intelligibility of speech in noise. I. POLLACK. *J. Acoust. Soc. Amer.*, **24,** 538–40 (*Sept.*, 1952).

The effect upon the intelligibility of speech in noise of the interaction of sharp frequency limiting and severe peak clipping was studied. The results are compared with previously reported results of similar tests with frequency-limited speech signals that were not subjected to amplitude distortion. The intelligibility of unclipped speech, relative to that of the peak-clipped signal under corresponding experimental conditions, is a function of the signal-to-noise (S/N) ratio under test and is, to a rough approximation, independent of the frequency range of the speech signal passed. At high S/N ratios, the intelligibility of the unclipped speech signal is higher than that of the severely peak-clipped signal. Under low S/N ratios, however, the intelligibility of the latter is considerably higher than that of the unclipped signal. A.

534.833

8754. Acoustic design of aircraft gas turbine test cells. R. O. FEHR, R. J. WELLS AND T. L. BRAY. *J. Acoust. Soc. Amer.*, **24,** 480–90 (*Sept.*, 1952).

Permissible sound levels were established for surrounding residential areas. The attenuation due to spherical divergence, and also the probable deviation due to varying atmospheric conditions, was determined. Thus, the sound level permissible at the exhaust stacks of the test cells was obtained. Knowing the noise level inside the test cell, the required sound attenuation of the stacks was calculated. Various acoustical treatments were investigated. An acoustical design is proposed which makes use of a combination of various duct treatments, and which meets the established design objectives. The permissible noise level inside the control room is discussed, and the required attenuation through the barrier between test cell and control room is calculated. A design for a control room meeting the established noise level criterion is proposed. A.

534.833.1

8755. On vibrations of certain elastic systems in a sound field. T. VOGEL. *Publ. Sci. Minist. Air* [*France*] *No.* 209, 79 *pp.* (1948) *In French.*

A study of the acoustical transmission coefficient for a wall or partition. For this coefficient, the author coins the optically inspired term "transparency." He derives an analytic expression for it in terms of air density, sound velocity and particle velocity on each side of the partition. For a single rectangular plate type of partition the force acting on the surface is given in terms of air density, sound velocity, incident particle velocity and plate velocity. Using the characteristic shape functions, the Lagrangian equations of motion of the plate in generalized co-ordinates are obtained. Thence, the required energy ratio is determined. The transmission coefficient so found is given in terms of an infinite series. A method is developed to approximate the coefficient by a finite inequality. Using Bessel functions, the coefficient for a circular plate is then determined. Next, the problem of oblique incidence is studied. The problem of double-walled partitions for normal incidence is treated in detail. There is considerable discussion of the air "coupling." Porous walls are treated briefly, as well as vibrations of finite amplitude. The results of an extensive experimental investigation are given for single bare plates with and without stiffeners, double walls with air between and plates with felt, asbestos and glass wool affixed to the surfaces. Reasonably good agreement is shown between experimental and theoretical sound-level reductions which are shown in a series of curves plotted on frequencies as abscissae.

APPLIED MECHANICS REVIEWS

534.843

8756. Radiation problems in architectural acoustics. J. BRILLOUIN. *Acustica*, **2**, 65–76 (*No.* 2, 1952) *In French.*

Experience, supported by theory, shows that the amount of energy radiated into a room (and, therefore, the ways of penetration of outside noise) cannot be deduced from the knowledge of the mean amplitude of vibration of the partition. In fact, flexural waves in a partition do not radiate unless their velocity be greater than that of sound in air; the "radiation index" of a partition can thus be widely different for forced and for free vibrations. A theory of the suspended ceiling is attempted, and some observations explained. Finally it is shown that transient phenomena may have peculiarities not found in the steady state, and some relevant experiments are discussed. A.

534.843

8757. Observations on geometrical architectural acoustics. E. MEYER AND W. KUHL. *Acustica*, **2**, 77–83 (*No.* 2, 1952) *In German.*

Deals with the first sound reflections following the direct beam from source to listener. The number of these reflections can be greatly increased by sound mirrors suitably tilted and placed at the upper parts of the side walls in the neighbourhood of the sound source. If these first reflections occur in the 50 msec interval after the arrival of the direct sound a reinforcement takes place. Some formulae are given relating this effect to the energy density in the diffuse sound field. The second part of the paper describes some practical applications to rooms, in which sound mirrors improve the hearing conditions and especially the intelligibility of speech. They are: the rebuilt opera house at Hamburg, the big hall in the students' hostel at Bonn and the theatre at Hanover. A.

534.843 : 534.231

8758. Standing wave patterns in studio acoustics. C. G. MAYO. *Acustica*, **2**, 49–64 (*No.* 2, 1952).

An approximate analysis is made of the sound field in a rectangular box excited by a spherical source. Two different kinds of characteristic frequencies are observed, one of which is the set of eigentones. A general picture is obtained of the relative importance of the various modes. High frequency eigentones are relatively unimportant. A.

534.844

8759. The reverberation times of ten British concert halls. P. H. PARKIN, W. E. SCHOLES AND A. G. DERBYSHIRE. *Acustica*, **2**, 97–100 (*No.* 3, 1952).

The reverberation time is still the only quantitative criterion that can be used in the acoustic design of concert halls; the cost of a hall depends to a considerable extent on the choice of the reverberation time. Little information has been published on measured reverberation times, and this paper gives the results of measurements in ten British concert halls, both full and empty. It also gives some results of an opinion survey, in which professional musicians were asked for their opinions on the acoustics of these halls. A.

534.844

8760. Reverberation time in baroque churches. W. LOTTERMOSER. *Acustica*, **2**, 109–11 (*No.* 3, 1952) *In German.*

The variation of reverberation time with frequency in some well-known baroque churches in upper Swabia and Alsace is reported, and the specially favourable acoustical properties of these buildings noted. A.

534.861.1 : 621.396.712.3(44)

8761. New studios of the Radiodiffusion Française. J. PUJOLLE. *Ann. Télécommun.*, **7**, 305–9 (*July–Aug.*, 1952) *In French.*

The materials and techniques employed to obtain the desired acoustical characteristics in 17 studios at Nancy, Lille, Nice and Pierre Bourdan are described.

G. HOWELLS (R)

534.88

8762. The thermal-noise limit in the detection of underwater acoustic signals. R. H. MELLEN. *J. Acoust. Soc. Amer.*, **24**, 478–80 (*Sept.*, 1952).

The criteria for an "optimum" hydrophone receiving system for underwater acoustic signals are considered, and the equilibrium thermal-noise pressure spectrum expression is shown. Experimental ambient sea-noise spectrum levels are in excess of the thermal noise at all frequencies below 25 kc/s. Extrapolation of experimental curves (−5 db/octave) shows intersection with thermal-noise spectrum (+6 db/octave) between 50 and 200 kc/s, depending on sea state (a ref. for a definition of "sea state" is given). The ambient-noise level is expressed as a function of the

equivalent temperature. Formulae are then derived for the required plane-wave signal level for which electrical signal-to-noise ratio is unity. The operating noise factor is defined in terms of the electroacoustical efficiency of the linear reversible hydrophone, the amplifier noise figure and the equivalent ambient-noise temperature for the sea condition and frequency under consideration. A.

OPTICS . RADIATION . SPECTRA 535

535.24 : 535.89

8763. The reproducibility of photometric equality measurements on a spectral source. J. SCHIESS. *Optik*, **9**, 312–18 (*No.* 7, 1952) *In German.*

The variations in equality settings in a split-field photometer are recorded as a function of the wavelength of the light and its brightness. The variations were obtained from a number of observers repeating the setting over a period of 1–23 days. The split-field photometer is said to have rather smaller variations than the flicker photometer. R. W. FISH

535.24 : 621.327.43

8764. Contribution to the photometry of fluorescent lamps. F. B. CARACCIOLO. *Elettrotecnica*, **39**, 239–45 (*May* 10–25, 1952) *In Italian.*

An experimental determination of the solid of light distribution for a fluorescent lamp. Two empirical formulae can be used to represent the polar curve in a plane containing the lamp axis, viz. $I(\gamma) = I_n[a \cos \gamma + (1 - a) \cos^2 \gamma]$ or $I(\gamma) = I_n \cos^m \gamma$ where I_n is the intensity normal to the axis and a and m are constants. It is found that the second gives a better approximation to the experimental curve when $m = 4/3$. From this expression two diagrams have been constructed to facilitate the calculation of the illumination on a plane respectively parallel or perpendicular to the lamp axis.

J. W. T. WALSH

535.242.62

8765. Reproducibility of flicker photometer measurements of spectral lights. J. SCHIESS. *Optik*, **9**, 274–80 (*No.* 6, 1952) *In German.*

Several observers made measurements of lights from different parts of the spectrum, using a flicker photometer, and repeated these measurements subsequently after various intervals of time. The results are given and the following conclusions are drawn: (1) for measurements spread over less than a week the reproducibility is fair for the wavelengths from 510 to 600 mμ, but much worse at the ends of the spectrum, (2) if the measurements are spread over 6 to 10 weeks, the reproducibility is bad throughout the spectrum.

J. W. T. WALSH

535.247.4 : 535.361.2 : 628.971.6

8766. Measurement of pavement surface characteristics. J. O. KRAEHENBUEHL. *Illum. Engng* [*N.Y.*] **47**, 278–87 (*May*, 1952).

Describes apparatus for measuring the reflection characteristics of road surface materials. This incorporates a photoelectric recording photometer. The results for new concrete are given, mainly in the form of a sinusoidal diagram, similar to an iso-candela diagram but with curves of equal luminance factor (termed in the paper "brightness coefficient"). There is a discussion on the subject of the most suitable form of diagram for exhibiting the results of measurements of this kind. J. W. T. WALSH

535.249 : 621.317.79

8767. Integrating light meter for fading tests. O. E. MILLER. *J. Opt. Soc. Amer.*, **42**, 661–2 (*Sept.*, 1952).

The instrument is designed to use only commercially available components and is robust and dependable. The d.c. measuring circuit is linked mechanically to the a.c. integrating circuit by means of a self-balancing potentiometer servo system. The time integral of the intensity is accumulated on a commercial kWh-meter. Linearity and accuracy are better than 1% of the full registration rate. A.

535.311 : 621.397.3

8768. Theory of parallax barriers. S. H. KAPLAN. *J. Soc. Mot. Pict. Televis. Engrs*, **59**, 11–21 (*July*, 1952).

The parallax barrier, which is a type of selective masking device now being applied in colour television and in stereoscopic imagery, is discussed. A brief history with the principle and geometric relationship underlying its operation is given. Various systems employing two or more image elements per aperture and utilizing the maximum image area are described. It is also shown that non-planar and non-parallel arrangements are possible, and that plane barrier surfaces may be coupled to non-planar image surfaces. Furthermore, lenses may replace the mechanical-type barriers resulting in a more light-efficient system. Formulae are presented and specific applications to multiple-colour television tubes are discussed. A.

535.312

8769. A new mirror multiplier. B. M. LEVIN. *Zh. Tekh. Fiz.*, **22**, 105–10 (*No.* 1, 1952) *In Russian.*

A method is described permitting of raising and varying the sensitivity of auto-collimation readings and photo-recording arrangements; this is accomplished through the corresponding selection of angles with the known multiplier having two mirrors.

Z. F. WOJNAR

535.316

8770. Precalculation of optical systems. M. HERZBERGER. *J. Opt. Soc. Amer.*, **42**, 637–40 (*Sept.*, 1952).

A necessary and sufficient condition is derived for a system of thin lenses with finite distances, in which image position and magnification can be corrected simultaneously for two colours. As an example, a nomogram is given for all colour-corrected photographic triplets. A.

535.317

8771. A general contribution formula for tangential rays. E. DELANO. *J. Opt. Soc. Amer.*, **42**, 631–3 (*Sept.*, 1952).

Consider any two optical systems which are axially symmetrical and composed of spherical surfaces. A general contribution formula is derived relating any tangential ray in one system with any tangential ray in the other system. As special cases of the general

formula, an exact spherical contribution formula, an exact coma contribution, an exact contribution formula for the final image height and others are derived. Exact spherical and coma contributions should be particularly useful for designing systems of very high aperture and small field, where zonal aberrations demand special consideration. The computing formulae are especially adapted to a well-known ray-tracing scheme. A.

535.317.9

8772. Iterative ray-tracing. W. WEINSTEIN. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 731–5 (*Sept.*, 1952).

An iterative ray-tracing method described by T. Smith (1945) is shown to give a divergent sequence of approximations in certain cases; when it converges it has only first-order convergence according to Hartree's classification of iterative processes. An iterative method which always gives second-order convergence is described and the significance of the successive approximations in terms of higher-order aberrations is discussed. A.

535.325

8773. Refractivity of naphthalene vapour. S. VENKATARAMAN. Letter in *Curr. Sci.*, **21**, 156–7 (*June*, 1952).

Brief details are given of a method, using a Rayleigh refractometer, by which the refractivity is found to be $(3341 \pm 64) \times 10^{-6}$. The refractivity is calculated from values of the polarizability of the molecule found firstly by applying the theory of anisotropy of the polarization field in liquids and secondly by using the refractive indices of the crystal. The values are 3217×10^{-6} and 3302×10^{-6} respectively, the latter being in good agreement with the present experimental value. H. G. JERRARD

535.33.07

8774. The application of a system of graduated diaphragms to Littrow's spectrograph (with a glass optical system). I. A. CAMUÑAS. Note in *An. Real Soc. Fis. y Quím.*, **47(A)** 45–6 (*Jan.–Feb.*, 1952) *In Spanish.*

By this method the calibration curve of the photographic emulsion was obtained in the visible region of the spectrum. L. PINCHERLE

535.33.07 : 535.339

8775. A small plane grating monochromator. W. G. FASTIE. *J. Opt. Soc. Amer.*, **42**, 641–7 (*Sept.*, 1952).

A spherical-mirror, autocollimating plane grating monochromator is described which is compact, stable and exhibits spectral resolution which is better than 50% of the theoretical value. The spectrometer is 30 in long and uses a 3 in wide grating with 30 000 lines/in. The optical system, although not in use in any modern spectrometer, was described by Ebert in 1889 (see abstract following). The aberration corrective arrangement of the spherical mirror leaves only astigmatism as a serious aberration. The use of curved slits to remove this effect of astigmatism is described. The mechanical-optical system is described in detail, and use of the instrument with a photomultiplier tube to record visible and ultraviolet emission spectra is described. Spectra are presented which demonstrate a second-order spectral resolution of 0·05Å in the visible and ultraviolet region. A.

535.33.07 : 535.339

8776. Image forming properties of the Ebert monochromator. W. G. FASTIE. *J. Opt. Soc. Amer.*, **42**, 647–51 (*Sept.*, 1952).

The high resolution obtained by the monochromator described in the preceding abstract has inspired the design of an *f*/6 spectrometer of that type for the infrared region. This paper describes the results of preliminary tests and calculations which show that the Ebert system is capable of near theoretical resolution at *f*/6 even when very long slits are used. Both slits must be curved to remove the effect of astigmatism and to avoid wavelength errors at the exit slit which arise from curvature of spectrum when a plane grating is employed. That the same curvature of slits simultaneously corrects these two image errors is a fortunate coincidence which makes the Ebert system appear to be superior to currently employed spectrometer optical systems. Comparison with other systems and discussion of the limitations of the Ebert system are presented. A.

535.33.07–14

8777. Realization of a spectroscope for millimetre waves. E. ROUBINE. *Rev. Tech. C.F.T.H., No.* 16, 21–44 (*Dec.*, 1951) *In French.*

Circuit details of a Stark effect spectroscope with phase-sensitive detection to give negative signals for the displaced lines. D. H. WHIFFEN

535.33.07–15

8778. Modification of the Beckmann model IR$_2$ infra-red spectrophotometer for use with external radiation sources. A. U. MOMIN. Letter in *J. Sci. Industr. Res.*, **11B**, 307–8 (*July*, 1952).

A periscopic attachment replacing the Nernst filament admits an external beam; this is useful in measuring long absorption columns. G. F. LOTHIAN

535.33.07–15

8779. A photocell amplifier for infra-red spectroscopy. D. A. H. BROWN. *J. Sci. Instrum.*, **29**, 292–4 (*Sept.*, 1952).

An amplifier has been developed primarily for use with photoconductive cells as detectors of infra-red radiation. The frequency chosen, 800 c/s, is about optimum for most cells of the lead sulphide type when used with chopped radiation. The bandwidth is 50 c/s and overall gain 2×10^7. Negative feedback reduces gain variations to less than $\pm\frac{1}{3}\%$ for a $\pm 10\%$ variation in power supplies. Noise level is equivalent to an input noise resistance of 50 kΩ. The amplifier is LC tuned. A.

535.33.07–15 : 621.314.2.029.424

8780. The design of thermocouple transformers for infra-red chopped beam systems. T. S. ROBINSON. *J. Sci. Instrum.*, **29**, 311–13 (*Oct.*, 1952).

Factors in the design of a transformer to be inserted between the thermocouple of an infra-red spectrometer and the input stage of an a.c. electronic amplifier are discussed. The principles evolved lead to a construction in which the effects of external interference are negligible, and the s./n. ratio closely approaches a maximum. A.

535.338

8781. Spectral behaviour of some five-atom heterocyclic basic substances in the Schüler discharge tube. G. Milazzo. *Experientia*, **8**, 259–61 (*No.* 7, 1952) *In German.*

The following substances were investigated in emission in the Schüler discharge tube: furan, pyrrole, thiophen, selenophen, N-methylpyrrole. Different radicals were observed depending on the particular molecule and on the particular pressure range. An emission continuum in the same spectral region and of the same structure for all molecules was also observed. The resulting electronic configuration of pyrrole is more similar to that of furan than to that of thiophen. On the other hand, the electronic configuration of thiophen together with the electronic configurations of selenophen and N-methylpyrrole are probably similar to that of benzene. The continuous spectra of emission are interpreted as recombination spectra of the radicals. A.

535.338.332

8782. A note on the wavestatistical deduction of the fine structure formula. S. Sanatani. Letter in *Sci. Cult.*, **17**, 476–7 (*May*, 1952).

A lack of rigour in Kar and Sen Gupta's derivation of the formula [see Abstr. 5330 (1949)] is pointed out and an alternative derivation given, still based on wavestatistical methods. L. PINCHERLE

535.338.4

8783. The complex band spectrum of nickel bromide. V. G. Krishnamurty. Letter in *Curr. Sci.*, **21**, 98 (*April*, 1952).

This spectrum was taken from 3900 to 5000Å. Three systems were identified. The wave numbers of the Q heads are tabulated. A. J. TAYLOR

535.338.4

8784. Band spectrum of oxides of calcium and magnesium. J. K. Patnaik. Letter in *Curr. Sci.*, **21**, 6–7 (*Jan.*, 1952).

The CaO bands are produced by the introduction of CaO into the lower electrode of a carbon or copper arc in air; the MgO spectrum is taken from burning Mg strips or from an arc in air with Mg electrodes. The results differ from those obtained previously. Some bands could be identified with bands found before, but many additional bands occurred. A. J. TAYLOR

535.338.42

8785. Electronic transitions in the complex band spectrum of nickel chloride. V. G. Krishnamurty. Letter in *Curr. Sci.*, **21**, 37–8 (*Feb.*, 1952).

It is found that the complexity in the band structure is caused by overlapping of different systems and by high multiplicity of the terms. Five systems of bands have been determined. A short analysis is given. See also abstract following. A. J. TAYLOR

535.338.42

8786. The complex band spectrum of nickel chloride. V. G. Krishnamurty. Letter in *Curr. Sci.*, **21**, 66 (*March*, 1952).

The spectrum of $NiCl_2$ has been obtained from 4900–3800Å. There is agreement with the bands found by More (1938), but several additional bands are found, which force a change in the assignment. Values of the vibrational constants are listed.

A. J. TAYLOR

535.343 : 539.23

8787. Lattice defects of high concentrations in alkali halides. R. Kaiser. *Z. Phys.*, **132**, 482–96 (*No.* 4, 1952) *In German.*

A method of producing thin films having a high concentration of lattice defects (1 to 2%), previously applied to metallic films, has been shown to be applicable also to the alkali halides. Absorption spectra of the resulting films are given for the systems KCl + K, NaCl + Na, KBr + K, KCl + Na, KCl + Ca, KCl + Ag, KCl + (AgCl + K).

P. T. LANDSBERG

535.343 : 539.23

8788. New light absorption in silver halides. W. Kaiser. *Z. Phys.*, **132**, 497–507 (*No.* 4, 1952) *In German.*

The same method as that referred to in the preceding abstract has been applied to silver halides. Absorption spectra are given for the systems AgCl + Ag, AgCl + Cu, AgCl + Au, AgBr + Ag. Some new absorption maxima have been found. P. T. LANDSBERG

535.343–14 : 539.133

8789. The microwave spectra, structure, dipole moment, and chlorine nuclear quadrupole coupling constants of methylene chloride. R. J. Myers and W. D. Gwinn. *J. Chem. Phys.*, **20**, 1420–7 (*Sept.*, 1952).

The microwave spectra of $CH_2Cl_2^{35}$, $CH_2Cl^{35}Cl^{37}$, $CH_2Cl_2^{37}$, $CDHCl_2^{35}$, $CDHCl^{35}Cl^{37}$, $CD_2Cl_2^{35}$ and $CD_2Cl^{35}Cl^{37}$ have been examined and effective moments of inertia have been determined for these seven isotopic species. From these data the effective bond distances and angles were determined as C — Cl distance = 1·7724 ± 0·0005Å, Cl — C — Cl angle = 111° 47′ ± 1′, C — H distance = 1·068 ± 0·005Å (average of all species) or 1·082Å (extrapolated to infinite hydrogen mass), and H — C — H angle = 112° 0′ ± 20′ (average of all species) or 112° 58′ (extrapolated to infinite hydrogen mass). The best value for the dipole moment of methylene chloride was found from the Stark splitting to be $1{\cdot}62 \pm 0{\cdot}02 \times 10^{-18}$ e.s.u. The chlorine nuclear quadrupole coupling constants were also determined and their relationship to the structure is discussed. A.

535.343.2

8790. On the bleaching of color centers (M-center) in KCl crystal with polarized light. M. Ueta. Note in *J. Phys. Soc. Japan*, **7**, 107–9 (*Jan.–Feb.*, 1952).

Absorption spectra are measured for M-centres in a crystal with (011) planes at 45° to monochromator slit during bleaching by M-band irradiation with plane of polarization alternately parallel to (011) and then to (0$\bar{1}$1) planes. The bleaching is more rapid for the (011) polarized radiation. The results favour Seitz's model for the M-centres, i.e. they verify their supposed C_{2v} symmetry. G. F. J. GARLICK

535.343.2

8791. Absorption of color centers in the region between F-band and M-band. Y. Uchida and H. Yagi. Note in *J. Phys. Soc. Japan*, **7**, 109–10 (*Jan.–Feb.*, 1952).

For LiF coloured by X-rays or electrons, six bands

occur between *F*- and *M*-centre bands with definite relations between the wave numbers of their maxima. Results suggest that all these bands are characteristic of a single type of centre. G. F. J. GARLICK

535.343.2–15

8792. The vibrational spectra of molecules and complex ions in crystals. VI. Carbon dioxide. W. E. OSBERG AND D. F. HORNIG. *J. Chem. Phys.*, **20**, 1345–7 (*Sept.*, 1952).

For Pt V, see Abstr. 6382 (1951). A previously reported discrepancy between the predicted and observed infrared spectrum of crystalline carbon dioxide is shown to arise from the presence of two peaks due to $C^{13}O_2$, a combination band involving a lattice frequency near 110 cm^{-1} and two reflection peaks. The infrared spectrum was studied at −190°c and apart from the previous features shows one component from ν_3 and two from ν_2, shifted very little from the gas frequencies. The difficulties encountered in interpreting the spectrum of this simple crystal occur quite generally in the spectra of more complicated substances. A.

535.343.3

8793. On the absorption spectra of quinones. H. HARTMANN AND E. LORENZ. *Z. Naturforsch.*, **7a**, 360–9 (*May*, 1952) *In German.*

As the first energy level, where one electron of the lone pairs of the oxygen in a carbonyl compound is excited among the mobile electrons, is lower than the first excited state of the same symmetry as the ground state, a very weak band can be observed of longer wavelength than the lowest strong band. In quinones, with two carbonyl groups, two such bands occur. The acene quinones can be divided into groups of compounds with similar longest main band, according to their molecule residues, when C=O groups are neglected. In these compounds, governed by their canonical structures, the double C=O bond is rigid and acts as an insulator. In higher condensed quinones the numerous polar structures, involving single C—O bonds, gain importance, and the spectra are similar to the corresponding hydrocarbons. Experimental data are given for a considerable number of quinones and the practical details described. A. J. TAYLOR

535.343.4

8794. Absolute absorption of the H_2 continuum. PO LEE AND G. L. WEISSLER. Note in *Astrophys. J.*, **115**, 570–1 (*May*, 1952).

A plot against λ is given of observed absorption coeffs. (using a grazing-incidence vacuum spectrograph and a constant intensity emission line source) from 480–880Å. The effect of diffuse H_2 absorption bands is evident, and the estimated ionization continuum gives the rather high oscillator strength of 0·79. D. L. EDWARDS

535.343.4

8795. Absolute oscillator strengths of chromium. F. B. ESTABROOK. Note in *Astrophys. J.*, **115**, 571–2 (*May*, 1952).

Using vapour pressure measurements by Speiser, Johnston and Blackburn, with spectroscopic *nf*-values, absolute *f*-values for 4290, 4275, 4254Å are found to be over 7 times the previously accepted values (with p.e. about 10%). D. L. EDWARDS

535.343.4

8796. Absorption spectrum of acetophenone. G. VISWANATH. Letter in *Curr. Sci.*, **21**, 159 (*June*, 1952).

An interpretation is suggested for the observed band heads in the absorption spectrum of acetophenone vapour. G. I. W. LLEWELYN

535.343.4–15

8797. High dispersion infra-red spectrum of CH_2=CHD. I. C. COURTOY AND M. DE HEMPTINNE. *Ann. Soc. Sci. Brux.*, **66**, 82–110 (*June*, 1952) *In French.*

535.343.4–15

8798. On the infra-red spectrum of gaseous hydrofluoric acid between 1400 cm^{-1} and 700 cm^{-1}. R. COULON. Letter in *J. Phys. Radium*, **13**, 371–2 (*June*, 1952) *In French.*

First results show bands near 770, 1025 and 1170 cm^{-1}; they are probably association bands. G. F. LOTHIAN

535.345

8799. Determination of the optical constants of calcium and application of Mie's theory to the coloration of fluorspar. M. MAYERL. *S.B. Öst. Akad. Wiss., IIa*, **160**, 31–8 (*No.* 1–5, 1951) *In German.*

The optical constants of calcium are determined by the Drude method using an evaporated layer of the metal on the hypotenuse face of a 45, 45, 90° glass prism. The method gives good agreement with previous results when a gold layer is used. Using Mie's theory the absorption spectra of spherical colloidal particles of calcium in CaF_2 crystals are calculated from these results for various sizes of particle. The absorption maximum moves to longer wavelength and broadens with increase in particle size. G. F. J. GARLICK

535.345

8800. Reciprocal property of the transmission coefficient of light through a multiple sheet. C. v. FRAGSTEIN. *Optik*, **9**, 337–59 (*No.* 8, 1952) *In German.*

This detailed study of light transmission through a sheet formed of layers with different properties illustrates the reciprocal property, viz. that the transmission coefficient is independent of direction if the surrounding medium is the same on the two sides. See also Abstr. 2851 (1947). P. M. DAVIDSON

535.371

8801. Luminescence phenomena in willemite phosphors. E. NAGY. *Acta Phys. Hungarica*, **1**, 115–26 (*No.* 2, 1951).

A brief account of some recent progress in the investigation of fluorescence. Data are given on the band complex of willemite fluorescence and phosphorescence at several temperatures and with varying manganese concentrations. The dielectric behaviour of these substances was also investigated and found to be closely connected with the fluorescence. These results are discussed in the light of the modern theory of solids and some interesting conclusions are drawn. A.

535.371

8802. Some optical properties of luminescent powders. Z. BODÓ. *Acta Phys. Hungarica*, **1**, 135–50 (*No.* 2, 1951).

Describes first the production of samples of uniform

grain sizes by means of the process of repeated sedimentation, from synthetic apatite activated by Mn and Sb. It has been determined that the brightness of this material is independent of the grain size, the reason for the decrease in light being the smaller excitation caused by the increased reflection. The summing of the diffused reflection of the powdered material and the application of the summing to determine the coefficient of absorption are described. The control of the method is with material of known absorption. In the above material the coefficient of absorption is 300 ± 60 cm. The control of result is carried out by means of photometering under the microscope. A.

535.371

8803. Notes on the rise and decay of willemite luminescence. G. GERGELY. Letter in *Acta Phys. Hungarica*, **1**, 197–8 (*No.* 2, 1951).

535.371

8804. Transfer and transport of energy by resonance processes in luminescent solids. T. P. J. BOTDEN. *Philips Res. Rep.*, **7**, 197–235 (*June*, 1952).

Further experimental and theoretical studies are made of energy transfer in non-photoconducting phosphors sensitized by secondary activator inclusions. Experiments refer to Ca and Sr orthophosphates activated by Ce and Mn and by Sn and Mn respectively, to Ca fluoro- and pyro-phosphates activated by Sb and Mn and by Sn and Mn respectively, to $CaCO_3$ activated by Pb or Tl and Mn and to Mg pyrophosphate activated by Ce or Th and Mn. A theoretical explanation of the sensitizing process is given by assuming that transfer of energy occurs from sensitizing impurity to activator ions situated on an adjacent cation site or from one sensitizing cation to another until one is reached which has an adjacent activator ion. The latter process is temperature-dependent. G. F. J. GARLICK

535.371

8805. The luminescence of the alkali iodides. J. BONANOMI AND J. ROSSEL. Letter in *Physica*, **18**, 486–8 (*June–July*, 1952) *In French.*

The luminescence characteristics of LiI, NaI, KI, RbI and CsI activated by Tl are examined over a temperature range of 77–300°K using a scintillation counter technique. Thermoluminescence curves show close agreement with those calculated from theory assuming a monomolecular process. G. F. J. GARLICK

535.371

8806. A note on the phosphorescence of proteins. P. DEBYE AND J. O. EDWARDS. Note in *Science*, **116**, 143–4 (*Aug.* 8, 1952).

Following examination of various proteins, 18 amino acids were studied to determine the groups in the proteins active in luminescence. Only three common aromatic amino acids, tyrosine, tryptophane and phenylalanine showed characteristic emissions, the others showing weak emissions probably due to traces of these three. Measurements made at 77°K and 193°K indicated two exponential decay processes with life-times of about 3 sec. The visible spectrum of the protein emission is dependent on pH values. The decay processes are temperature-independent but a feeble long-duration phosphorescence occurs, probably due to a denaturing of the proteins by the u.v. light. G. F. J. GARLICK

535.371

8807. On the physics of crystal phosphors. II. F. STÖCKMANN. *Naturwissenschaften*, **39**, 246–54 (*No.* 11, 1952) *In German.*

For Pt I, see Abstr. 6419 (1952). The review of luminescence, conductivity and related effects in phosphors is continued. Topics include the quantitative treatment of phosphorescence, relation between phosphorescence and fluorescence, thermoluminescence and the energy spectrum of trapping states. Phosphors considered include alkali and silver halides and Zn, Cd and alkaline earth sulphides. Sixty-three references are given to past and modern work in the field. G. F. J. GARLICK

535.371 : 621.327.43

8808. New phosphors for fluorescent lamps. J. L. OUWELTJES. *Philips Tech. Rev.*, **13**, 346–51 (*June*, 1952).

A light source for general lighting purposes must meet certain requirements as regards colour and spectral distribution of the light emitted (colour rendering). Until recently, low-pressure fluorescent lamps have fulfilled these requirements if coated with a mixture of two phosphors, Zn–Be silicate and Mg tungstate. To avoid the difficulties entailed by the use of such a mixture in the manufacture of fluorescent lamps, a phosphor was sought which would by itself emit white light. Phosphors having this property were discovered in the halophosphate group; these phosphors contain two kinds of activating atoms; the one, Sb, emits blue light and the other, Mn, yellow. The spectral distribution and the colour triangle are used as bases for determining the colour and matching properties of the phosphors, respectively. It appears that some control can be effected by varying the composition of the phosphor. The efficiency of fluorescent lamps with halophosphate phosphors is greater than that of lamps coated with the silicate tungstate mixture. In those cases where good colour matching is essential, also in the red region, red-luminescing Mg arsenate and a small quantity of willemite are mixed with the phosphor. Because of the excellent properties of Mg arsenate, the efficiency is reduced only slightly by the inclusion of this substance, thus producing a lamp (the new "de Luxe" lamp) which ensures high efficiency and excellent colour matching properties. A.

535.371 : 628.9

8809. Luminescence as applied to lighting. H. G. JENKINS AND A. H. MCKEAG. *Trans Illum. Engng Soc.* [*Lond.*] **17**, 159–82 (*No.* 7, 1952).

An account is given of the theoretical aspects of photoluminescence and the more important inorganic phosphors are mentioned. The factors which determine the luminous performance of both low- and high-pressure fluorescent lamps are discussed. Reference is made to a number of general matters concerned with luminescence, including the phenomena of electroluminescence. A.

535.372

8810. Spectra in phosphorescence. E. NAGY AND G. GERGELY. *Acta Phys. Hungarica*, **1**, 127–33 (*No.* 2, 1951).

Authors have investigated the emission spectrum of an artificial willemite in fluorescence and phosphorescence at various durations of excitation and at various instants after the cessation of excitation. It was found that by ultraviolet excitation with a revolving phosphoroscope the yellow sub-band had disappeared in phosphorescence. The phosphorescence decay curve after pulsed cathode-ray excitation was measured with spectrographical resolution in various parts of the spectrum with multiplier, amplifier and oscilloscope. A very rapid decay was found in the blue part of the spectrum. A.

535.372

8811. A vibrational analysis of the fluorescence of naphthalene vapor. O. SCHNEPP AND D. S. MCCLURE. *J. Chem. Phys.*, **20**, 1375–83 (*Sept.*, 1952).

The fluorescence spectrum of naphthalene vapour has been photographed and found, under suitable conditions, to consist of a number of discrete bands. Thirty-nine bands were measured and a vibrational analysis was carried out making use of assignments of infrared and Raman fundamentals. The analysis indicates that the transition observed is forbidden by symmetry and made weakly allowed by a molecular vibration of frequency 478 cm^{-1} belonging to the representation $b2_u$. This indicates that the wave function of the lowest excited singlet state of naphthalene belongs to the irreducible representation A_g or B_{1g} of the point group D_{2h}. A.

535.375.51

8812. The determination of the intensities of Raman lines. E. J. ROSENBAUM, C. C. CERATO AND J. L. LAUER. *J. Opt. Soc. Amer.*, **42**, 670–2 (*Sept.*, 1952).

Existing methods for the quantitative evaluation of Raman line intensities are briefly reviewed and attention is called to the desirability of obtaining intensity data which permit comparisons between laboratories using different apparatus. A simple method for obtaining such data is described, using the 459 cm^{-1} Raman line of CCl_4 as a reference and eliminating the properties of the spectrometer and detector by a calibration with the radiation from an incandescent lamp which was standardized as Illuminant *A* by the National Bureau of Standards. The calibration is tested by calculating the intensity ratios of Stokes to anti-Stokes lines and also the ratios of pairs of Raman lines when excited by two mercury lines. Consistency with theory is found which indicates that the method of calibration is satisfactory. A.

535.375.54 : 548.736.5

Orientation of the water molecules in the crystal $ClO_4Li.3H_2O$. *See Abstr.* 9192

535.375.55

8813. A study by the Raman effect of acetic acid in solution in various organic solvents. S. FÉNÉANT. *C.R. Acad. Sci.* [*Paris*] **235**, 240–2 (*July* 21, 1952) *In French.*

The Raman spectra of solutions of acetic acid of different concentrations in dioxan, ether, acetonitrile and nitromethane are given and interpreted.

G. I. W. LLEWELYN

535.376

8814. The decay of calcium tungstate and zinc oxide phosphors after excitation by an electron beam. H. GOBRECHT, D. HAHN AND H. DAMMANN. *Z. Phys.*, **132**, 239–47 (*No.* 3, 1952) *In German.*

The decay of $CaWO_4$ is found to be exponential with a time constant of $2{\cdot}5\times10^{-5}$ sec, while ZnO shows a hyperbolic decay which agrees with the results of other workers on its trapping states.

G. F. J. GARLICK

535.376 : 537.312.5 : 537.529

8815. Free motion of electrons in crystals, electroluminescence effects and dielectric breakdown phenomena. D. CURIE. *J. Phys. Radium*, **13**, 317–25 (*June*, 1952) *In French.*

In the first part the work of Gudden and Pohl [*Proc. Phys. Soc.* [*Lond.*] **49**, 3–31 (1937)] on photoconductivity is reviewed, and the effective cross-section of traps for electrons deduced as $\sim10^{-18}$ cm^2 a factor of 10^4 smaller than the spatial value for the traps. From electroluminescence experiments the effective "cross-sections of excitation" of traps and centres are deduced and are 10^6 times greater than the capture value. A modified form of the Mott photoconductivity theory is used to explain these differences. Finally, an analogy is drawn between the acceleration process for electrons in electroluminescence and that proposed in various theories of dielectric breakdown. The treatment given by Geeger and Teller for breakdown seems most suitable for application to electroluminescence.

G. F. J. GARLICK

535.39

8816. Graphical determination of the Fresnel coefficients for oblique incidence at the surface separating a transparent medium from an absorbing medium. P. BOUSQUET. *J. Phys. Radium*, **13**, 294–6 (*May*, 1952) *In French.*

Gives a graphical method for determining $[\sqrt{(n_1^2 - n_0^2 \sin^2\theta)}]/n_0$, where n_1 is complex and n_0 and θ real. By equating the expression to $p - jq$ and squaring, it is shown that two families of rectangular hyperbolae can be drawn, each characteristic of certain functions of n_1, n_0 and θ. Their point of intersection gives p and q. A further simple calculation gives the reflection factors for both components of the incident light. Good agreement with calculation is found using the values of n_1 and n_0 for silver.

N. CORCORAN

535.39

8817. The reflectance of thin cellulose nitrate films. L. HARRIS AND J. K. BEASLEY. *J. Opt. Soc. Amer.*, **42**, 634–6 (*Sept.*, 1952).

A calibration is given for the weight per unit area of thin cellulose nitrate films in terms of the reflectance of such films for monochromatic visible radiation. Such a calibration has been used in the determination of the weight per unit area of thin cellulose nitrate films upon which gold smokes were later deposited. A.

535.421

8818. Homometric diffraction gratings. L. BRÚ AND M. CUBERO. *An. Real Soc. Fis. y Quim.*, **47(A)** 35–6 (*Jan.–Feb.*, 1952) *In Spanish.*

An experimental study of diffraction patterns pro-

duced by two-dimensional gratings and reproducing X-ray diffraction figures. L. PINCHERLE

535.421

8819. On the preservation of groove-form in replicas of diffraction gratings. G. D. DEW. *J. Sci. Instrum.*, **29**, 277–9 (*Sept.*, 1952).

The Merton-N.P.L. process of preparing replicas of flat diffraction gratings has been described in which it has been shown that the diffracted wavefront of the replica can be made to resemble very closely that of the parent grating. The present paper describes a detailed investigation of the changes of groove form which occur during various stages of the replica process and shows how the process may be modified to produce replicas having photometric properties almost identical with those of the original gratings. A.

535.43

8820. Light scattering by a dielectric sphere of refractive index $n = 4/3$. E. DE BARY. *Optik*, **9**, 319–22 (*No.* 7, 1952) *In German.*

A supplement to the work of Holl (1948–9) by extending the range of the published tables.

J. M. HOUGH

535.43 : 518.2

Tables of light-scattering functions for spherical particles. *See Abstr.* 8624

535.51

8821. A monochromatic depolarizer. B. H. BILLINGS. *Cienc. e Invest.*, **8**, 99–112 (*March*, 1952) *In Spanish.*

The theory of crystal depolarizers is given in terms of the matrix calculus of Mueller. The depolarizers described consist of two wave plates made from A.D.P. crystals. A method of testing these crystals using a rotating analyser is described. See also Abstr. 1689 (1952). R. W. FISH

535.581

8822. Measurement of the dispersion of birefringence in the infra-red. A. M. VERGNOUX AND S. THÉRON. Letter in *J. Phys. Radium*, **13**, 368 (*June*, 1952) *In French.*

The method is described. A beam of monochromatic light from a quartz prism spectrometer is rendered parallel, linearly polarized and passed through a Bravais compensator to fall finally upon a suitable receiver. Insertion of the specimen causes a change from which the birefringence is found to within 2 or 3%. H. G. JERRARD

535.6.08

8823. A new high sensitivity differential colorimeter. L. G. GLASSER AND D. J. TROY. *J. Opt. Soc. Amer.*, **42**, 652–60 (*Sept.*, 1952).

A new high precision, tristimulus, filter colorimeter suitable both for research and for industrial use has been developed. The instrument can reproducibly measure C.I.E. (International Commission on Illumination) tristimulus values X, Y and Z, and ratios of tristimulus values, sample to standard, to four significant figures for most colours. Colour differences considerably smaller than those which a trained observer can visually detect can be measured on all colours from whites to blacks of about density 4. The luminous apparent reflectance of carefully polished black glass has been measured as 0·012%. Tables of value functions and alignment charts have been prepared which permit rapid conversion of instrumental measurements into colour co-ordinates or co-ordinate differences of equal visual spacing in a modified Adams chromatic value system. A slide-rule has been devised for the rapid calculation of total colour difference, ΔE. A.

535.7 : 612.84

Physiological optics. *See Abstr.* 9253–60

535.822 : 537.534.74 : 778.34

8824. Microscopes for the measurement of scattering. M. G. E. COSYNS. *Bull. Cent. Phys. Nucleaire Bruxelles, No.* 30, 6 *pp.* (1951) *In French.*

Two prototype microscopes are described for the accurate measurement of small-angle scattering in tracks recorded in nuclear emulsions. In one instrument the light issuing from the microscope objective is split into two beams which are later recombined to form a double image in the plane of the eyepiece, one image being laterally reversed with respect to the other. The reversed image can be rotated about the centre of the field until the grains forming the track under investigation are exactly aligned. The degree of rotation then defines the angle the track makes with a fixed direction. The other instrument is intended for use with the sagittal method of measuring the small-angle scattering and the design and construction of the mechanical stage is such that the accuracy in the linearity and reproducibility in regular displacements of the stage is 0·05 μ.

A. C. COATES

535.822.5

8825. Counting soil algae by direct fluorescence microscopy. Y. T. TCHAN. Letter in *Nature* [*Lond.*] **170**, 328–9 (*Aug.* 23, 1952).

Only direct microscopy can be used in studying soil algae, although its use is limited by the small number of algae present. A method using the red fluorescence of chlorophylls illuminated with blue or u.v. light is suggested for detecting and counting. Practical details of the technique are given. R. W. FISH

535.822.9

8826. Study of the resolving power of the phase-contrast microscope. Observations on the structure of diffraction phenomena in the presence of a coherent background. M. FRANÇON AND A. SÁEZ. *An. Real Soc. Esp. Fis. y Quím.*, **47(A)** 275–88 (*Nov.–Dec.*, 1951) *In Spanish.*

Resolving power is studied on a phase-contrast microscope fitted with a ring-shaped phase plate. The area of the plate is maintained constant and the resolving power is calculated according to the position of the plate in the pupil. It is found that resolving power improves as the radius of the phase plate increases. This is principally due to the structural changes of the diffraction phenomenon in the presence of a coherent background set up by an oblique light-source. A.

535.822.9 : 535.42

8827. Artificial holograms and astigmatism. G. L. ROGERS. *Proc. Roy. Soc. Edinb. A*, **63**, 313–25 (*Pt* 4, 1952).

Experiments in diffraction microscopy, previously described [Abstr. 5714 (1952)], are here continued. Special emphasis is now laid on verifying the theory

by the production of an "artificial" hologram, by non-diffractive means, from data calculated for a relatively simple object. The assumed object is then reconstructed in the usual apparatus. A type II linear zone plate of limited width is studied as a particular case of an artificial hologram. It gives rise to an unexpected black artefact, which is explained by a detailed analysis of this particular zone plate, and is shown to be due to its limited extent. Experiments on twisting the linear zone plate skew to the reconstructing beam show that the effective focal length is affected astigmatically by a factor proportional to $\cos^2\theta$, where θ is the angle of twist, for lines parallel to the axis of twist. Lines perpendicular to the axis of twist are unaffected. The production of a hologram in an astigmatic pencil and its subsequent reconstruction while skew to a parallel beam is described. It is found that the focal length differences can be corrected in this way, but that the lateral scale factors are only partially rectified. A.

535.822.9 : 537.531

Optics of the focusing X-ray microscope. *See Abstr.* 8885

535.824.3

8828. Brightness diagrams for microscope illuminators. G. SCHENDELL. *Optik*, **9**, 219–21 (*No.* 5, 1952) *In German.*

The distribution of illumination in a microscope is determined as a function of the distance of the light source from the microscope, of the collimating lens position and of the diaphragm opening for a number of objectives. R. W. FISH

535.89

8829. Investigations concerning light sources for spectrum analysis. I. Interrupted arc source for spectrum analysis. Á. BARDÓCZ. *Acta Phys. Hungarica*, **1**, 247–60 (*No.* 3, 1952).

Describes the fundamental principles of interrupted arc sources, and gives a general survey of the types of apparatus constructed up to now. In continuation it describes in detail the practical construction of, and the results obtained by means of an interrupted arc source of such a kind hitherto only described in patent specifications. The substantial feature of this source consists in the provision of a high-voltage ignition circuit which contains no high-voltage element other than a Tesla transformer. The production of the igniting voltage is effected by means of a low-voltage controlled circuit. The possibilities for adjustment of the equipment for different operating conditions is greater than that of existing types of apparatus, whilst its reproducibility is equal to the reproducibility of the best types of apparatus known up to date. A.

HEAT 536

536.2

8830. Application of the theorem of Thevenin to problems in heat transmission. A. BLANC. *C.R. Acad. Sci.* [*Paris*] **235**, 136–8 (*July* 16, 1952) *In French.*

Problems arising with several sources supplying heat to large and small thermal capacities through networks of thermal resistances are best solved by applying this operator to the appropriate matrices. E. H. DOCK

536.2 : 533.15

An electrical analogue for the study of diffusion processes with internal gains or losses. *See Abstr.* 8731

536.212.3 : 537.226

Thermal conductivity of electrets. *See Abstr.* 8851

536.23

8831. The thermal conductivity of rare gases. W. G. KANNULUIK AND E. H. CARMAN. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 701–9 (*Sept.*, 1952).

The thermal conductivity of the rare gases is determined in absolute measure by a "hot wire" method at selected temperatures in the range −183°C to 306°C. The experimental values of the thermal conductivity are shown to be in good agreement with the values calculated according to the recent theory of Hirschfelder, Bird and Spotz in the above range of temperature. The quantity $\varepsilon = K/\eta c_v$ is shown to be independent of the temperature, but the value of ε increases slowly with the molecular weight from a value 2·43 for He to a value 2·58 for Xe. A.

536.24 : 534.39

Flows near a heated solid body in a standing sound wave. *See Abstr.* 8750

536.24 : 534.39

The effect of acoustic vibrations of finite amplitude on the boundary layer. *See Abstr.* 8751

536.423.1 : 531.714.2

Surface follower for measuring rate of evaporation of molten metals. *See Abstr.* 8696

536.423.15

8832. Behaviour of the integral of the Gibbs–Duhem–Margules equation for binary mixtures in the neighbourhood of its singularities. A. HUBER. *S.B. Öst. Akad. Wiss., IIa*, **160**, 181–97 (*No.* 6–10, 1951) *In German.*

Mathematical. An analytical treatment of the integration of the Gibbs–Duhem–Margules differential equation for the vapour pressure of binary mixtures is given. A. J. MEE

536.46 : 535.33.03

8833. Rotational temperatures of OH in several flames. H. P. BROIDA AND G. T. LALOS. *J. Chem. Phys.*, **20**, 1466–71 (*Sept.*, 1952).

The intensity of OH emission from various small regions of Bunsen-type flames of hydrogen, acetylene, methane and propane, premixed with oxygen, has been observed spectroscopically and corresponding rotational temperatures have been determined by an iso-intensity method. An ultraviolet grating monochromator of high resolution was used; fuel to oxygen ratios were varied from about 0·5 to 2 times the stoichiometric value; and rotational temperatures were determined at several positions within each flame. The measured temperatures of the reaction zone varied little with mixture ratio for a given fuel and were greater than adiabatic, suggesting a lack of thermal equilibrium. In the hot gases beyond the reaction zone, however, evidence was found of both rotational and electronic equilibrium. The concentration of thermally produced OH in the burned

gases was found to be so great that it tends to mask the emission from the reaction zone. A.

536.461

8834. Twin flames. W. G. Berl and D. Dembrow. Letter in *Nature* [*Lond.*] **170,** 367 (*Aug.* 30, 1952).

For a range of air-fuel ratios, the reaction zone of a Bunsen flame using a mixture of propane and diborane as fuel separates into 2 distinct luminous regions, the first believed to be due to oxidation of diborane, the second to oxidation of propane. As the air-fuel ratio is decreased, the second zone gradually disappears and is replaced by a diffusion-flame structure. A plot of flame velocity against mixture-strength exhibits two maxima, one near the stoichiometric air-fuel ratio for B_2H_6-air (30 cm/sec), the other near that for $(B_2H_6 + C_3H_8)$-air (approx. 45 cm/sec). A. SCHOFIELD

536.462 : 536.521

8835. Using the sun to measure temperatures of flames in the laboratory. R. H. Wilson, Jr. *Publ. Astron. Soc. Pacific,* **64,** 105–8 (*June,* 1952).

A standard line-reversal pyrometer was used to measure the temp. of a H_2–F_2 flame; up to 30% F_2, carbon arcs or tungsten filaments could be used as comparison radiators, but the temp. of a 50%–F_2 flame is higher than that of orthodox sources. Hence in such cases, the sun was used as a comparison radiator; to avoid errors arising from the solar D lines, measurements were based on reversal of the Li 6708Å line, which is practically absent from the solar spectrum. From the mean of 50 results, the maximum temp. of the H_2–F_2 flame was found to be 4300°K. A. SCHOFIELD

536.48

8836. The thermal conductivity of solid helium. F. J. Webb, K. R. Wilkinson and J. Wilks. *Proc. Roy. Soc. A,* **214,** 546–63 (*Oct.* 9, 1952).

The thermal conductivities of crystals of solid He at densities between 0·194 and 0·218 g/cm³ have been measured at liquid-He temperatures. In order to interpret the results, the specific heat of solid helium at these densities has been measured from 0·6 to 1·4°K. The range of densities employed is sufficient to allow the observation of Debye characteristic temperatures varying by 40%, and of thermal conductivities varying by factors of over 10. It is shown that the conductivity measurements are in accord with the "umklapp" type of thermal resistance derived by Peierls (1929, 1935). Further work was restricted by the difficulty of obtaining good single crystals in narrow tubes, but measurements of the conductivity at one density were obtained down to 0·3°K. In this region the conductivity is limited by boundary scattering and is higher than that observed by other authors for liquid He II at similar temperatures. A.

536.48

8837. Pressure effect on the second sound velocity in liquid helium II. A. Kondoh, S. Nakajima and M. Shimizu. *Progr. Theor. Phys.,* **6,** 939–44 (*Nov.–Dec.,* 1951).

The pressure dependence of the second sound velocity in liquid helium II is explained by taking account of the phonon entropy on the basis of the models of Tisza and Landau. To calculate the velocity use is made of the generalized formula derived by Gorter and Usui, according to which, however, the second sound velocity at the absolute zero of temperature in Landau's model is $\sqrt{3}/4$ times the ordinary sound velocity. The discrepancy between this value and that predicted by Landau is due to the different assumptions made on the entropy and the relaxation time. A.

536.5

8838. Measurement of transient surface temperatures. R. A. Huggins, I. B. Roll and H. Udin. *Rev. Sci. Instrum.,* **23,** 467–70 (*Sept.,* 1952).

Deals with the design, construction and operation of apparatus to produce, measure and record transient surface temperature cycles of the type produced at and near a typical steel spot weld. A.

536.5

8839. The determination of very high distribution temperatures. E. Palm. *Ann. Phys.* [*Lpz.*] **10,** 327–35 (*No.* 6–7, 1952) *In German.*

The parameter T in the Planck radiation equation is called the "distribution temperature" after Reeb and Richter [*Lichttechnik,* **2,** 186 (1950)], and a method is outlined for determining this in terms of the intensity ratio at two wavelengths by using the Wien approximation. Other methods are considered briefly and the new one is applied to sources of high temperature such as the positive crater of a carbon arc and astrophysical objects. E. H. DOCK

536.51 : 53.088.22

8840. Errors in temperature measurement due to the construction and situation of thermometers. F. Lieneweg. *Arch. tech. Messen, Issue No.* 196 (*Ref. V* 2165–2) 107–10 (*May,* 1952) *In German.*

Errors due to the lag of the thermometer, heat transfer to and from the thermometer and the surrounding medium, and, for the resistance thermometer, the heating error, are considered. By expressing the various heat exchanges in terms of equivalent thermal conductivities, and by using the values, obtained experimentally, of the errors of a thermometer in the two media, still air and stationary water, it is shown that the errors for any medium can be expressed simply. Graphical representations to assist calculations in any practical case are given. S. WEINTROUB

536.62.088

8841. On the calorimetric heat exchange correction. H. D. Vasileff. *J. Appl. Phys.,* **23,** 979–83 (*Sept.,* 1952).

A method has been developed for determining the low temperature heat capacity of a cylindrical sample from heating and cooling curves. The effect of temperature gradient in the sample is included. A.

536.631

8842. Metasilicate chains and the theory of thermal capacity. V. V. Tarasov. *Dokl. Akad. Nauk SSSR,* **84,** 321–4 (*No.* 2, 1952) *In Russian.*

Using the Debye theory the specific heats of $(SiO_3)_\infty$ chains are calculated. The observed specific heats of $MgSiO_3$ and Na_2SiO_3 fit the calculated curves very closely from 50–300°K with characteristic temperatures of 1285° and 1323° respectively. The specific heat of wollastonite, $CaSiO_3$, cannot be accounted for if

$(SiO_3)_\infty$ chains as in the above two compounds are postulated, and is probably due to the presence of Si_3O_9 rings. A. L. MACKAY

536.631

8843. The representation of the specific heat of solids by Debye and Einstein terms. W. BRENIG AND M. SCHRÖDER. *Z. Phys.*, **132**, 312–17 (*No.* 3, 1952) *In German.*

Considers an extension of the Debye theory by adding Einstein terms to the frequency spectrum. The results are compared with those that have been derived rigorously by means of lattice theory.

E. P. WOHLFARTH

536.663.3

8844. On the realization of a measurement of the ratio of the specific heats of gases. M. AUBERT-HUETZ. *C.R. Acad. Sci.* [*Paris*] **235**, 25–7 (*July* 7, 1952) *In French.*

Discusses further improvements in a method due to Assmann (1852) for the determination of γ. The improved apparatus gives good results for CO_2 and N_2 and the following values for hydrocarbons at 125°C and 76·1 cm: benzene, 1·07; hexane, 1·13; heptane, 1·06 [see also Abstr. 3193 (1949)].

F. E. HOARE

536.663.3

8845. On a new method of measuring the ratio of the specific heats of gases. M. AUBERT-HUETZ. *C.R. Acad. Sci.* [*Paris*] **235**, 141–3 (*July* 16, 1952) *In French.*

A method of self-maintenance of the oscillations in Assmann's apparatus is described. It is claimed that measurements are very rapid and the apparatus suitable for high temperatures (see preceding abstract).

F. E. HOARE

THERMODYNAMICS 536.7/.8

536.7

8846. Total thermodynamics. V. N. NJEGOVAN. *Arh. Kem.*, **22**, 116–70 (1950) *In German.*

536.7

8847. Thermodynamics of irreversible processes. I. PRIGOGINE. *Appl. Mech. Rev.*, **5**, 193–5 (*May*, 1952).

Review article outlining the general theory and some of the problems to which it may be applied.

F. E. HOARE

536.7 : 531.01

8848. The application of theoretical mechanics to thermodynamics. I. FÉNYES. *Z. Phys.*, **132**, 140–5 (*No.* 2, 1952) *In German.*

The description of a thermodynamic system with two degrees of freedom can be made formally equivalent to that of a mechanical system with two degrees of freedom and two independent, non-holonomic constraints. The mechanical analogues of V, S, p and T are q_1, p_2, $\dot{p}_1$ and $\dot{q}_2$ respectively; the analogues of the internal energy and the Helmholtz free energy are the Hamiltonian and the Lagrangian; p_1 and q_2 have no direct thermodynamic interpretation. The resulting formalism is used to discuss the axiomatic foundations and possible extensions of thermodynamics. In particular, it is claimed that a "quantal" thermodynamics is impossible because the uncertainty relations involve the undefined variables. R. O. DAVIES

536.75

8849. On the rate of irreversible production of entropy. N. HASHITSUME. *Progr. Theor. Phys.*, **7**, 225–40 (*Feb.*, 1952).

In the case of some gaseous substances (a simple gas, a gaseous mixture of reacting molecules, and free electrons in metals) the equation of entropy transport is derived from the Boltzmann's kinetic theory. The definition of entropy used in this derivation is the one given by the Boltzmann's H-functional. The expression of the rate of irreversible entropy production appearing in the above-mentioned equation is essentially the same as that given by Tolman–Fine and others in their thermodynamical theories. A.

ELECTRICITY 537

ELECTROSTATICS . DIELECTRICS 537.2

537.226

8850. Apparatus for the detection of the electric quadrupole resonance. M. BUYLE-BODIN. *C.R. Acad. Sci.* [*Paris*] **235**, 292–4 (*July* 28, 1952) *In French.*

Based on methods used for magnetic resonance, in particular on some ideas utilized in Pound's spectrograph [Abstr. 5941 (1950)]. The detecting circuit, which contains the specimen, determines the frequency of the generator. Three different ways of using the instrument are described. L. PINCHERLE

537.226 : 536.212.3

8851. Experiments on the thermal conductivity of electrets. J. VAN CALKER AND R. ARNOLD. *Z. Phys.*, **132**, 318–29 (*No.* 3, 1952) *In German.*

Various waxlike substances have thermal conductivity values which depend on the magnitude of an applied electric field after being rendered ferroelectric. This effect is due to the presence of small amounts of water and may be removed by dehydration. The differences in behaviour in d.c. and a.c. fields are interpreted on the basis of a theoretical model concerning the deformation of frozen-in water drops by the application of the field. E. P. WOHLFARTH

537.226.2

8852. High frequency dispersion in *n*-propanol. R. H. COLE AND D. W. DAVIDSON. *J. Chem. Phys.*, **20**, 1389–91 (*Sept.*, 1952).

Two dispersion regions in the liquid in addition to the primary dispersion have been measured at audio- and radiofrequencies below −120°C, which make small but significant contributions to the dielectric constant. Both move rapidly to lower frequencies with decreasing temperature and the relaxation times of the intermediate dispersion are 200 times smaller than for the primary one. The temperature and frequency dependences are those to be expected for orientation rather than induced polarization. A.

537.226.2

8853. The dielectric properties of water in solutions. G. H. HAGGIS, J. B. HASTED AND T. J. BUCHANAN. *J. Chem. Phys.*, **20**, 1452–65 (*Sept.*, 1952).

Results of dielectric constant and loss measurements at $\lambda = 9{\cdot}22$, $3{\cdot}175$ and $1{\cdot}264$ cm are given for a wide variety of aqueous solutions of ions and organic molecules. The water relaxation time is shortened by positive ions and lengthened by hydrogen bond-forming molecules. The properties of water are treated by a statistical method in which the numbers of molecules in four, three, two, one and zero-bonded states are estimated from dielectric and latent heat data. Fair agreement with experiment is obtained in calculating the static dielectric constant of ice at 0° and water from 0–370°c, using Kirkwood's dielectric theory and Verwey's calculation of the dipole moment of a four-bonded water molecule. The effects of temperature and solutes on the water relaxation time are discussed in terms of this statistical method. The effective number of water molecules "irrotationally bound," i.e. prevented from turning in the electric field by the ion or the organic molecule, is estimated from the depression of the low frequency dielectric constant, using a dielectric theory of mixtures. This number is zero for uncharged solute molecules but is finite for organic or inorganic ions. A.

537.226.2

8854. On the dielectric constant of the water in wet clay. L. S. PALMER. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 674–8 (*Sept.*, 1952).

Some recent experimental values of the variation of the dielectric constant of wet clay with moisture content cannot be explained on the assumption that the clay particles and water molecules form a simple mixture. The results can, however, be theoretically deduced by considering relatively dry clay to consist of closely packed water-coated clay particles in an air matrix and relatively wet clay to consist of clay particles uniformly distributed in a water matrix, the water associated with the clay having an effective dielectric constant which varies exponentially from that of "bound" water (about 3) to that of "free" water (about 80) as the percentage of water is gradually increased. The conclusion follows that water films have a very low dielectric constant compared with that of water in bulk. A.

537.226.2

8855. Dielectric dispersion in pure polar liquids at very high radio frequencies. III. The effect of electrolytes in solution. J. A. LANE AND J. A. SAXTON. *Proc. Roy. Soc. A*, **214**, 531–45 (*No.* 1119, 1952).

For Pt II, see Abstr. 6489 (1952). A description is given of measurements at millimetre and centimetre wavelengths of absorption in electrolytic solutions, up to concentrations of about 3N, with water and methyl alcohol as solvents. The observations are analysed in terms of Debye's basic theory of dispersion in a polar dielectric, and it is shown what modifications to the theory are necessary to take account of the ionic conductivity produced by an electrolyte. Measurements on aqueous solutions of sodium chloride are discussed in relation to Hückel's theory of electrolytic solutions. A.

537.226.2 : 539.32

8856. On the theory of the dielectric, piezoelectric, and elastic properties of $NH_4H_2PO_4$. T. NAGAMIYA. *Progr. Theor. Phys.*, **7**, 275–84 (*March*, 1952).

The theory of KH_2PO_4 developed by Yomosa and the present writer [Abstr. 2445 (1950)] can be applied to the upper phase of $NH_4H_2PO_4$ without any alteration. All the experimental data can be represented by the formulae of this theory. It is shown that this theory has a more general character than it appears to have, as based upon Slater's model of KH_2PO_4, and, when applied to Rochelle salt, it is equivalent to Mueller's interaction theory. Some discussions on the phase change in $NH_4H_2PO_4$ are given. A.

537.226.2 : 621.315.615 : 621.317.335.3

8857. The determination of complex dielectric constants of absorptive liquids by microwave interferometry. F. H. BRANIN, JR. *J. Appl. Phys.*, **23**, 990–7 (*Sept.*, 1952).

Describes both a travelling-wave method and a standing-wave method for determining complex dielectric constants of liquids from measurements made at 10 cm wavelength with a travelling probe immersed in a dielectric-filled slotted line. An interferometric null technique was developed for improving the accuracy of the measurements, especially in highly absorptive media. In the travelling-wave method, absolute measurements of both wavelength and absorption index can be made simultaneously; from these two quantities the complex dielectric constant is readily computed. In the standing-wave method, the absorption index is determined graphically from the power-standing-wave ratio while the wavelength is obtained by a modified null technique. For low loss media, a simplified standing-wave method is practical whereby the absorption index is obtained from measurements of the breadths of successive minima of the standing wave. Corrections for the finite resistance of the short circuit used in the standing-wave method and for conductor losses along the slotted line are fully treated. A.

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311.3

8858. The conductivity change in polyethylene during γ-irradiation. S. MAYBURG AND W. L. LAWRENCE. *J. Appl. Phys.*, **23**, 1006–11 (*Sept.*, 1952).

The effect of Co^{60} γ-irradiation on the d.c. conductivity σ of polyethylene has been determined up to an intensity I of 4000 roentgens per hour at room temperature. The equation $\sigma/\sigma_{00} = 1 + (I/I_0)^{\frac{1}{2}}$ describes the data where σ_{00} is the conductivity without radiation and is the order of 10^{-18} (ohm cm)$^{-1}$ and I_0 is 20 roentgen/hr. Measurements at liquid N temperatures give a factor of 20 decrease in the normal conductivity and a factor of 25 decrease in the radiation-induced conductivity below their respective room temperature values. The temperature data serves to suggest an ionic mechanism for electrical conduction in polyethylene as opposed to an electronic

mechanism. In fact, the ion contributing most to the conduction in the polyethylene may well be the proton. A.

537.311.31

8859. The electrical resistance of thin zinc layers with lattice defects. J. NIEBUHR. *Z. Phys.*, **132**, 468–81 (*No.* 4, 1952) *In German.*

Investigations on layers having thicknesses between 200Å and 2000Å and condensation temperatures below 200°K have been carried out. Reproducible results, practically independent of the rate of condensation, may be obtained under these conditions. Graphs have been obtained for the specific resistance, (*a*) as a function of temperature for various layer thicknesses and various condensation temperatures, and (*b*) as a function of layer thickness for various condensation temperatures. The greater part of curves (*b*) appear to be in good agreement with a formula due to Sondheimer. P. T. LANDSBERG

537.311.32

8860. Electronic conduction in crystalline insulators. W. FRANZ. *Z. Phys.*, **132**, 285–311 (*No.* 3, 1952) *In German.*

The basis of the theory of homogeneous electronic conduction in crystalline insulators is discussed and developed. The field and energy conditions for (*a*) ionization and migration of ions, (*b*) ionization and strong internal field emission from the *F*-band, and (*c*) purely field emission, are considered. The results are compared with experiment for KBr. Behaviour of non-polar crystals and the problems of temperature variation are also considered. C. A. HOGARTH

537.311.32 : 536.48

8861. Carbon thermometer-heaters for use at low temperatures. Effects of particle size and adsorption of hydrogen or helium. T. H. GEBALLE, D. N. LYON, J. M. WHELAN AND W. F. GIAUQUE. *Rev. Sci. Instrum.*, **23**, 489–92 (*Sept.*, 1952).

Measurements of the electrical resistance of C blacks have been made for various particle sizes, from 1° to 295°K. The smaller sizes have larger resistances and larger negative temperature coefficients of resistance. The effect of magnetic fields at liquid He temperatures is very small in all cases but increases somewhat as particle size decreases. The effect of adsorption of He gas on the electrical resistance is very small at the temperatures of liquid H. At the temperatures of liquid He the resistance at first increases, and then decreases below the original value, as the amount of He absorption is increased to saturation. A similar effect is observed when H is adsorbed at liquid H temperatures. When adsorbed H or He gases are pumped off, the effect is found to be reversible within the small limit of error. A.

537.311.33

8862. Study of the conductivity of semiconductors and application to systems of mixed oxides. C. GUILLAUD AND R. BERTRAND. *J. Rech. Cent. Nat. Rech. Sci.*, **4**, 118–30 (*March*, 1952) *In French.*

The usual theory of conduction in semiconductors is outlined. Experiments on the variation of resistance with temperature and composition for sintered mixtures of Fe_2O_3 with MnO, ZnO and MgO respectively are described. Certain proportions give useful thermistor materials of very high sensitivity. C. A. HOGARTH

537.311.33

8863. Carrier concentrations and Fermi levels in semi-conductors. J. S. BLAKEMORE. *Elect. Commun.*, **29**, 131–54 (*June*, 1952).

The statistical theory of free charge carrier concentrations and the Fermi level is reviewed and developed systematically using Fermi–Dirac statistics. Approximations to both classical and completely degenerate solids are considered and the errors involved calculated. The position of the Fermi level for a solid in which both chemical impurities and crystal defects are present is discussed, and in particular Ge and Si before and after particle bombardment are considered. C. A. HOGARTH

537.311.33

8864. On the high frequency behaviour of the barrier layer rectifier. W. SCHOTTKY. *Z. Phys.*, **132**, 261–84 (*No.* 3, 1952) *In German.*

The author extends his well-known theory of barrier layer rectification. It is shown how the capacitance measurements made by various workers may be explained on the assumption of the existence of a reserve layer between the exhaustion layer at the semiconductor surface and the interior of the crystal. The reserve layer is considered to be void of free carriers under normal conditions although the concentration of defect centres is the same as in the crystal interior. The origin of the surface layers is considered for semiconductors not completely ionized at room temperature such as Cu_2O and Si. C. A. HOGARTH

537.311.33 : 621.314.63

8865. On the inertia of the forward conductivity of germanium diodes. T. EINSELE. *Z. angew. Phys.*, **4**, 183–5 (*No.* 5, 1952) *In German.*

A pulse technique has been used to show that the final forward conductivity in a Ge diode establishes itself in times of the order of 1 μsec. The effect is pronounced for diodes having high reverse resistances, and was too small to be detected in the case of silicon diodes. P. T. LANDSBERG

537.312.5

8866. Photoelectric characteristics of an electron multiplier with beryllium-copper electrodes in the ultra violet region as far as 1500Å. V. SCHWETZOFF, S. ROBIN AND B. VODAR. Letter in *J. Phys. Radium*, **13**, 369–70 (*June*, 1952) *In French.*

537.312.5

8867. Photoconductivity of violanthrone. H. AKAMATU AND H. INOKUCHI. *J. Chem. Phys.*, **20**, 1481–3 (*Sept.*, 1952).

Photoconductivity of violanthrone, iso-violanthrone and pyranthrone, the organic semiconductors, has been investigated. From the threshold of spectral response of photoelectric current, the energy gap between the full ground band and the empty excited band was estimated as 0·84 eV, 0·93 eV and 1·14 eV, respectively. These results are in good agreement with that estimated from the temperature dependence

of resistivity, and furthermore with the optical absorption of crystals. A.

537.312.5

8868. On the rise and decay of photoconductivity in single crystals of CdS. J. FASSBENDER AND B. SERAPHIN. *Ann. Phys.* [*Lpz.*] **10,** 374–94 (*No.* 6–7, 1952) *In German.*

For six single crystals of CdS the rise and decay of photoconductivity are measured under excitation by rectangular pulses of light of different intensities and wavelength. The rise of current follows a hyperbolic tangent function. The decay curve shows an initial hyperbolic form followed by an exponential decay. With increasing light intensity the initial rate of rise and decay increases but the exponential decay is unaffected. Dependence on excitation wavelength and field strength is not found. The results can be quantitatively explained by a monomolecular and a bimolecular recombination mechanism and numerical values of the coefficients are obtained. G. F. J. GARLICK

537.312.5 : 537.529 : 535.376

Free motion of electrons in crystals, electroluminescence effects and dielectric breakdown phenomena. *See Abstr.* 8815

537.312.62

8869. On the interaction of the lattice vibrations with the conduction electrons. T. NISHIYAMA. Letter in *Progr. Theor. Phys.*, **6,** 897–8 (*Sept.–Oct.*, 1951).

A contribution to the foundation of Fröhlich's theory of superconductivity, with special emphasis on the effect of the Coulomb interaction forces.

P. T. LANDSBERG

537.312.62

8870. Volume variation of superconductors. H. KOPPE. Note in *Z. Naturforsch.*, **7a,** 445 (*June*, 1952) *In German.*

An extension of Heisenberg's theory leads to a value of approx. 10^{-7} for the fractional change in volume between the normal and superconducting states of a metal. C. A. HOGARTH

537.312.62

8871. Measurements on superconductivity of thin tin layers. I. A. VAN ITTERBEEK, L. DE GREVE AND L. VAN GERVEN. *Meded. K. Vlaamse Acad. Wetensch. Belg.*, **14,** 28 *pp.* (*No.* 5, 1952).

In this paper are described some measurements on the superconductivity of thin Sn layers, realized by cathodic sputtering in A. The macroscopic thickness of these films, determined by weighing, varies between 300 and 100 mμ. It is found that the transition temperature is higher than for the bulk metal, being highest for the thickest films. The transition curve is generally very sharp. Above the transition point the resistance decreases with increasing current, especially with the thinnest films. Under the transition temperature the resistance increases with increasing current as can be expected. Simultaneously the structure of these Sn films are studied by means of the electron-microscope. The films were observed to consist of small grains on a continuous underlayer, of which the dimensions have been estimated. A.

537.312.62

8872. On the superconductivity of niobium nitride. (Communications on superconductivity. III. Erlangen.) H. RÖGENER. *Z. Phys.*, **132,** 446–67 (*No.* 4, 1952) *In German.*

For Pt II, see Abstr. 5794 (1952). Specimens with 42 to 45 atom % N consist partly of a phase with a cubic face-centred metal atom lattice and partly of a mixture of this phase and a phase with a tetragonal lattice. Specimens with a larger N content have only the former phase. Increase of the N from 42 to 46% causes an increase in resistivity ρ at 293°K from 3×10^{-5} to 10×10^{-5} ohm cm (in some cases to 29×10^{-5}). $\rho_{20\cdot4°}/\rho_{293°}$ increases from 0·25 to 1·18, the transition temperature from 11°K to 14·2–16°K and the transition interval decreases from 2° to 0·2–0·3°. An oxygen content decreases the transition temperature. No hysteresis is found with pure specimens nor with those containing Ti, Zr, Ta, O. H. LONDON

537.312.62

8873. On the phase transition between super- and normal conductor in the critical magnetic field. F. BECK. *Ann. Phys.* [*Lpz.*] **10,** 317–26 (*No.* 6–7, 1952) *In German.*

The equations of the London theory are solved for a slow continuous translation of the boundary between superconductor and normal conductor for the case of an infinite superconducting semi-space. The result justifies the derivation of the critical field strength from the conservation of energy by H. London (1935). H. LONDON

537.312.62 : 538.3

On Planck's formulation of the law of the inertia of energy. *See Abstr.* 8947

537.363

8874. Electrophoresis apparatus of high resolution with instantaneous separation. F. STRUSS AND G. URBAN. Note in *Naturwissenschaften*, **39,** 300–1 (*No.* 13, 1952) *In German.*

Details are given of a concave mirror cell for electrophoresis, and the optical arrangement for use with it. The minimum detectable refractive index gradient is said to be 5×10^{-6} cm^{-1} and the minimum measurable refractive index difference 5×10^{-5}. A sample photograph is shown. R. W. FISH

ELECTRIC DISCHARGES 537.52

537.523.3

8875. Corona discharge between point and plate. L. WAGNER. *Arch. Elektrotech.*, **40,** 331–42 (*No.* 6, 1952) *In German.*

Using an improved oscillographic technique the nature of the discharge and its variation with potential were studied. To explain the results, modifications in the existing theory are suggested. P. M. DAVIDSON

537.523.4/.5

8876. The transition from the spark- to the arc discharge. B. GÄNGER. *Bull. Ass. Suisse Elect.*, **43,** 626–33 (*July* 26, 1952) *In German.*

Briefly examines Toepler's expression for the spark

resistance and applies this to the spark-arc transition; a more recent view is also discussed, but owing to lack of experimental data no definite conclusion is reached. F. LLEWELLYN JONES

537.523.4 : 621.3.015.5

8877. The behaviour of electronegative gases at breakdown field strengths. U. NEUBERT. *Arch. Elektrotech.*, **40**, 370–5 (*No.* 6, 1952) *In German.*

Tabulates data of sparking voltages between 19·85 mm dia. spheres in CCl_2F_2, CCl_4, $CHCl_3$, CH_2, Cl_2, CH_3Cl and CH_4. Experiments were also carried out on these gases mixed with air and hydrogen and the results are exhibited graphically. Discharge mechanisms are not discussed. J. D. CRAGGS

537.525.5

8878. The threshold gas pressure required to sustain a stable arc in a magnetic field. N. L. ALLEN. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 697–701 (*Sept.*, 1952).

Measurements of the minimum pressure required for the operation of stable, pulsed, high-current arcs in H and air, in strong longitudinal magnetic fields, have been compared with earlier results obtained with He. The values obtained are shown to be approximately those predicted by theoretical reasoning from the earlier work. Some relevant processes occurring in the discharge are discussed. A.

537.523.5 : 537.525.5

8879. The effect of [discharge] contraction on the variations of temperature and field strength near the cathode. G. ECKER. *Z. Phys.*, **132**, 248–60 (*No.* 3, 1952) *In German.*

Gives a detailed theoretical treatment of that region near the cathode in an arc (or spark) discharge where the plasma channel suffers constriction, until it meets the cathode spot. Temperatures and current densities, which may be $\sim 35\,000$ A/cm^2, in this transitional part of the discharge column, are studied. J. D. CRAGGS

537.525

8880. Reliability of probe measurements in hot cathode gas diodes. G. WEHNER AND G. MEDICUS. *J. Appl. Phys.*, **23**, 1035–46 (*Sept.*, 1952).

Experimental investigations show that Langmuir probe measurements can give quite erroneous results, due to work function changes of the probe, insulating layers on the probe surface, or different work functions at different places of the probe. The deposition of evaporated cathode compounds, the adsorption of O released from oxide cathodes, and the sputtering and evaporation from the probe may change the work function of a pure W probe in time scales of seconds. In oxide cathode tubes especially, it is necessary to measure immediately after the probe has been thoroughly cleaned. An $X-Y$ plotter, which recorded the whole probe characteristic in seconds, was found to be most suitable. No deviation from the Maxwellian velocity distribution of the plasma electrons could be found over a range of nearly 4 orders of magnitude in probe current, even in oxide cathode tubes under conditions where such deviations have been found by other authors. A.

537.525.5 : 621.385.2 : 621.3.014.31

8881. Studies of externally heated hot cathode arcs. II. The anode-glow mode. W. M. WEBSTER, E. O. JOHNSON AND L. MALTER. *RCA Rev.*, **13**, 163–
(*June*, 1952).

For Pt I, see Abstr. 1824 (1952). The prese paper gives a more detailed treatment of the anod glow mode wherein all ionization and excitati occur in a thin electron sheath close to the ano surface. The processes of ion generation and loss a cylindrical diode are treated analytically and th equated to obtain an expression for the volt-ampe characteristic of the discharge. It is found that t anode current varies as the 4th power of the excess the applied anode voltage over the ionizatic potential, and that the ratio of anode current to t rate of ion generation is dependent only upon t nature of the gas filling and the tube geometr The correspondence between this analysis and exper ment is good if ion losses to the oxide cathode a taken into account. These losses are ascribed to no uniformities of potential along the cathode surfac Experimental evidence shows that the plasma densit distribution is one in which the lowest diffusio mode predominates. Measurements of ion an electron currents to segmented electrodes whic bound the plasma show that the distribution cosinusoidal in the axial direction and characteristi of a zero-order Bessel function in the radial directio

537.525.8 : 537.525.7

8882. Influence of light on the secondary emission i a low frequency electrodeless discharge: Joshi effec A. P. SAXENA AND N. A. RAMAIAH. Letter in *Chem. Phys.*, **20**, 1342 (*Aug.*, 1952).

Describes the pulses, observed oscillographically and produced in 50 c/s discharges in simplified Joshi ozonizer tubes. The suggested mechanism agrees wit that of Harries and von Engel [Abstr. 5814 (1952)]. J. D. CRAGG

537.525.92 : 538.565 : 621.396.611.4 : 621.317.33

Methods of measuring the properties of ionized gase at high frequencies: Measurement of discharge admit tance and electron density. *See Abstr.* 8954

537.529 : 537.312.5 : 535.37

Free motion of electrons in crystals, electrolumines cence effects and dielectric breakdown phenomena *See Abstr.* 8815

X-RAYS 537.531

537.531 : 535.317.1 : 778.33

8883. Effect of focal spot size on shape and structure of X-ray images. A. FRANTZELL. *Acta Radiol.* [*Stockholm*] **35**, 265–76 (1951).

Enlarged images of objects less than the focal spot of the X-ray tube in width are subject to misrepresentation owing to an eclipse effect due to penumbra being greater than the object width. Images of wires intentionally magnified $\times 2$ were apparently magnified $\times 40$ as measured on the film, so that the usual methods for computing size do not apply. It is shown that spherical objects were projected as square images due to the influence of a square focal spot. Variation in intensity across the focal spot is shown

better in pinhole radiographs with a direct magnification or with a greater pinhole film distance. Microdensitometer readings across the focal-spot picture do not indicate a serious variation in intensity.

PHOTOGRAPHIC ABSTRACTS

537.531 : 535.343

8884. The X-ray *K* absorption edges of covalently bonded Cr, Mn, Fe, and Ni. G. MITCHELL AND W. W. BEEMAN. *J. Chem. Phys.*, **20**, 1298–301 (*Aug.*, 1952).

Some recently measured absorption edges of covalent nickel complexes and edges of Cr, Mn and Fe in similar complexes already in the literature. Low energy absorption (generally resolved as a line) is observed in all complexes where empty $4p$ orbital is expected from chemical or magnetic data. From the position of the line it is concluded that the metal ion is near neutral in the covalent complex. Where the $4p$ orbital is completely used in bonding, no low energy absorption line is observed. The method may be useful as an additional experimental check on the assignment of bonding orbitals. A.

537.531 : 535.822.9

8885. Optics of the focusing X-ray microscope. J. DYSON. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 580–9 (*Aug.*, 1952).

A brief description is given of Kirkpatrick and Baez X-ray reflecting microscope. The types of aberration possible in optical systems without axial symmetry are discussed and the effect of spherical aberration on the diffraction pattern of an object point is evaluated. The resolving power of a circular mirror is calculated, and a method of correcting field obliquity is described. A method is given for the design of a figured mirror to give smaller spherical aberration with zero field obliquity. Design equations are given for a system employing two circular mirrors in each plane, by which spherical aberration, obliquity and curvature of field can be corrected. The computed performance of the system is described. A.

537.531 : 535.822.9

8886. Diffraction microscopy with X-rays. M. E. HAINE AND T. MULVEY. Letter in *Nature* [*Lond.*] **170**, 202–3 (*Aug.* 2, 1952).

Points out that the predicted resolution of 10^{-5} cm put forward by Baez [Abstr. 6435 (1952)] is not possible of achievement owing to limitations of the size of the source and the resolution of the photographic plate. Similar conclusions to those reached by Baez were obtained by the authors (not yet published). J. THEWLIS

537.531 : 545.824

8887. Determination of the ratio of the atomic concentrations of thorium and uranium in minerals, by X-ray emission spectrography. M. TOURNAY. *C.R. Acad. Sci.* [*Paris*] **234**, 2527–9 (*June* 23, 1952) *In French.*

The emission lines U $L\beta_2$ ($\lambda = 75\,314$ X) and Th $L\beta_1$ ($\lambda = 76\,363$ X) are compared directly, using Siegbahn's result that $I(\mathrm{Th}L\beta_1)/I(\mathrm{U}L\beta_2) = 2{\cdot}21$ for equal amounts. $\log(I_{\mathrm{Th}}/I_{\mathrm{U}})$ plotted against $\log(n_{\mathrm{Th}}/n_{\mathrm{U}})$ gives a straight line, for all minerals with $n_{\mathrm{Th}}/n_{\mathrm{U}}$ between 9 and 0·03. C. TURNER

537.531.08 : 537.571

8888. Ionization of liquids by radiation. L. S. TAYLOR. *J. Chem. Phys.*, **48**, 168–71 (*March–April*, 1951).

Recent work in the author's laboratory is reviewed briefly. The ultimate aim is to measure radiation dosage in tissue by direct ionization. Previous experiments with CS_2 have been repeated with refinements, including a new 10 kV square-wave voltage source, and newly designed glass cells. There is a possibility that Jaffe's theory of columnar ionization may not apply when heavy doses of X-rays are used. A method of measuring X-ray intensities of 10^5 r/min is outlined. Here, saturation is not normally possible, but a beam 0·05 mm × 2 mm is used, with a plate separation of 2 mm. Preliminary results warrant pursuing this method. D. V. MABBS

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533.7

8889. Relative probabilities in a continuous electron beam. P. MOURMANT. *Radio Franç., No.* 6, 19–24 (*June*, 1952) *In French.*

An introduction to the theory of fluctuation in electron beams. The probability distribution in space and time are calculated in an elementary way.

A. H. W. BECK

537.533.72 : 548.74

An electron diffraction apparatus with Geiger–Müller counters. *See Abstr.* 9206

537.533.72 : 621.3.013 : 621.318.4

8890. The magnetic field of circular coils and its application to β-spectroscopy. A. MOUSSA AND J.-B. BELLICARD. *J. Rech. Cent. Nat. Rech. Sci.*, **4**, 131–5 (*March*, 1952) *In French.*

The well-known [Abstr. 484 (1951)] formula for H_z due to a circular conductor, in terms of complete elliptic integrals, is derived and the convergence of the Legendre polynomial formulae discussed. RH_z/i is tabulated to 4 decimals for $\alpha = 0(0{\cdot}05)1{\cdot}30$, $\zeta = 0(0{\cdot}1)1{\cdot}0$, where R = radius of conductor, i = current in e.m.u., $\alpha = r/R$, $\zeta = z/R$. This table has been used by the authors to design an iron-free stigmatic focuser [see Abstr. 5833 (1952)].

J. C. E. JENNINGS

537.533.74

8891. The Born approximation in electron diffraction. V. SCHOMAKER AND R. GLAUBER. Letter in *Nature* [*Lond.*] **170**, 290–1 (*Aug.* 16, 1952).

The use of the first Born approximation for the electron wave scattered by an atom, which is almost universal in electron diffraction work, neglects a phase-shift on scattering, which is approximately proportional to the atomic number and depends on the angle of scattering. Such neglect may lead to incorrect bond lengths in gas scattering or to intensity anomalies in crystal diffraction. J. THEWLIS

537.533.74

8892. The scattering of electrons by oblique foils. W. Bothe. *S.B. Heidelberg Akad. Wiss.* (*Math.-nat. Kl.*) *No.* 7, 12 *pp.* (1951) *In German.*

The distribution is worked out for electrons emerging from a foil which they entered at a given angle and in which they suffered one large deviation in addition to a Gaussian multiple diffusion.

W. J. SWIATECKI

537.533.74

8893. Single scattering of electrons on atomic nuclei. E. Kinzinger and W. Bothe. *Z. Naturforsch.*, **7a**, 390–401 (*June*, 1952) *In German.*

Using an electrostatic generator at 245 MeV the differential cross-sections of Ni, Ag and Au relative to Al and the absolute cross-section for Al were measured in the range 30–150°. For $\theta < 70°$ (and for Al at all angles) agreement with Mott's formula was found but for $\theta > 70°$ and increasing Z the experimental values are too low (by 37% for Au at 150°). W. J. SWIATECKI

537.533.74

8894. The scattering of positrons by nuclei. H. N. Yadav. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 672–3 (*Aug.*, 1952).

Results of calculations for positron energies of 1–10 MeV and nuclei of $Z = 10$ to 80 are given.

J. J. WILKINS

537.534 : 621.384.61

8895. Swedish cyclotron. *Atomics* [*Lond.*] **3**, 195–8 (*Aug.*, 1952).

The cyclotron at the Nobel Institute for Physics, Stockholm, designed to accelerate neutrons to 25 MeV is described. See also Abstr. 4396 (1952).

L. R. SHEPHERD

537.534 : 621.384.611

8896. The Oak Ridge 86-inch cyclotron. R. S. Livingston. *Nature* [*Lond.*] **170**, 221–3 (*Aug.* 9, 1952).

The high-current proton cyclotron, which produces more than 1 mA of protons at 24 MeV, is described. The magnet is oriented so that the dees are suspended vertically, and the proton orbits are in a vertical plane. A single-valve grounded-grid oscillator produces up to 400 kV between the dees, which are biased to −1 kV to achieve satisfactory starting and stable operation. Induced radioactivity of the dees is reduced by a graphite lining. Beam energy calibrations and target arrangements are described.

J. J. WILKINS

537.534.72 : 621.396.615.17

8897. A mass spectrometer recorder with a short response time. R. Valentin and G. Philbert. Letter in *J. Phys. Radium*, **13**, 247–8 (*April*, 1952) *In French.*

Circuits are given for producing a magnetic time base for an oscillograph. Repetition frequencies up to 10/second for the system were obtained. The time base has been adopted for use with the mass spectrometer designed by one of the authors. F. R. HOLT

537.534.74

8898. Elastic scattering and neutralization of low velocity hydrogen ions in ethane and propane. J. H. Simons and S. A. McAllister. *J. Chem. Phys.*, 1431–6 (*Sept.*, 1952).

The low velocity scattering of H^+, H_2^+ and in both ethane and propane have been measure ion velocities of less than 150 V. Ion neutraliza was detected and measured for all three ions in t hydrocarbons and elastic scattering potential fi tions evaluated for all six interactions. The scatte of hydrogen ions in the first four members of series of straight chain saturated hydrocarbons now be compared, and it is shown that they chang a systematic manner.

537.534.74 : 778.34 : 535.

Microscopes for the measurement of scattering nuclear plates. *See Abstr.* 8824

DISCHARGE TUBES . COUNTERS 537.54

537.

8899. An ion source. D. Kamke. *Z. Naturforsc* **7a**, 341–4 (*May*, 1952) *In German.*

A canal-ray type of ion source is described wh gives 700 μA, of 20 keV, protons for a total pov consumption of 90 W. J. HUGI

537.5

8900. Geiger–Müller counters for soft X-ra W. Ostrowski. *Acta Phys. Polon.*, **11**, 81–6 (*No.* 1951).

The dependence of the efficiency of G.M. count on A pressure for the X-ray wavelengths K_α (1·9Å) was investigated. The results obtained ag with a formula deduced for the dependency of t efficiency upon pressure. Small discrepancies are d to the increase of dead-time at higher pressures. T investigated counter attained maximum efficien (about 50%) at the pressure of 41 cm Hg. The wo of an A-alcohol G.M. counter up to 64 cm pressure was also tested.

537.5

8901. On the dipping counter. T. Oshida, Miwa and T. Kato. Note in *J. Phys. Soc. Japan*, 114–15 (*Jan.–Feb.*, 1952).

Gives the method of construction of an immersi Geiger counter with 20–30 mg/cm² glass walls: thin cylinder has its ends sealed to thicker tub which fit in it. F. R. HO

537.5

8902. Operation of halogen quenched Geiger–Müll counter tubes. R. D. Phillips. Letter in *Researc* [*Lond.*] **5**, 242 (*May*, 1952).

Work on Br-quenched G.M. counters shows th as the capacity placed across the counter is progre sively decreased there is a continuous increase plateau length, a reduction of pulse duration and possible lengthening of counter life. It is recom mended that the total capacity across these counte be less than 50 $\mu\mu$F. L. E. MUSSE

537.5

8903. On the starting voltage of counter tube K. H. Lauterjung. *Z. Naturforsch.*, **7a**, 344– (*May*, 1952) *In German.*

Gives a short derivation of starting voltages f

self-quenched and for simple gas fillings, and compares the calculated results with experimental data. Gas fillings studied include: O_2, N_2, He, H_2, A, A/alcohol (ethyl or methyl alcohol) and A/acetone. The results are expressed in nomograms. J. D. CRAGGS

537.542

8904. Colloidal graphite in the preparation of samples for gas-flow counting. A. F. REID AND M. C. ROBBINS. *Science*, **116**, 148–9 (*Aug.* 8, 1952).

It was shown that the lack of reproducibility for counting samples in a gas flow counter was probably due to the source charging up and disturbing the counter field distribution. Reproducibility could be achieved by making the source conducting by the addition of colloidal graphite. J. HUGHES

537.542

8905. A remark on the space-charge sheath of the Geiger counter. D. H. WILKINSON. *Rev. Sci. Instrum.*, **23**, 463–4 (*Sept.*, 1952).

The popular notion of the Geiger counter space-charge sheath as a thin expanding shell is shown to require modification. Owing to the considerable charge transported in the sheath it grows in thickness as it crosses to the cathode and may occupy more than half the total volume of the counter. The attendant wide straggle in arrival time of the positive ions at the cathode may explain, to some degree, the time distribution of spurious counts. A.

537.542

8906. Scintillation alpha counting of rocks and minerals. J. L. KULP, D. HOLLAND AND H. L. VOLCHOK. *Trans Amer. Geophys. Un.*, **33**, 101–13 (*Feb.*, 1952).

Two types of counters have been studied. In one type a lucite cone is used to gather light flashes from a much larger surface area of sample than is possible with a photomultiplier tube alone. However, the gain in count rate is overbalanced by decreased pulse height, loss of plateau and additional correction factors. In the second type of counter no cone is used, but the sample area is essentially infinite with respect to the sensitive area of the photomultiplier tube. In this situation a count rate is obtained which is 119% of that of the theoretical count of a thin source. Under these conditions the background can be reduced to 0·35 counts per cm^2 per hour. Experiments to define the source of the background of the counters are described. A.

537.542

8907. The phoswich—a multiple phosphor. D. H. WILKINSON. *Rev. Sci. Instrum.*, **23**, 414–17 (*Aug.*, 1952).

The combination of fast and slow phosphors with a single photomultiplier has coincidence and anti-coincidence properties. The fast phosphor gives a sharp spike on the leading edge of the pulse due to the slow phosphor if a charged particle traverses both phosphors. This makes possible the construction of highly directional phosphors, phosphors responding only to neutral radiations and phosphors free of wall effects. The transparency of sodium iodide (thallium) and stilbene to each other's radiations is demonstrated; these phosphors form a possible, though not ideal, pair. A.

537.542

8908. Low energy counting with a new liquid scintillation solute. F. N. HAYES, R. D. HIEBERT AND R. L. SCHUCH. *Science*, **116**, 140 (*Aug.* 8, 1952).

For use at 0°C with photomultipliers the usual *p*-terphenyl solution is poor because of its low solubility in toluene at this temperature. To overcome this 2,5-diphenyloxazole is used at concentrations of 3 g/l of toluene. Using 30 ml of this solution 35% of the disintegrations of dissolved C^{14}-benzoic acid are counted compared with 7% counted for *p*-terphenyl in dioxane-water solution under similar conditions. G. F. J. GARLICK

537.542

8909. Internal filling counters for counting low-energy β-particles. M. GRENON AND R. VIALLARD. Letter in *J. Phys. Radium*, **13**, 310–11 (*May*, 1952) *In French.*

A counter for gaseous β-emitters is described. The simple glass construction permits rapid evacuation and refilling and gives stable characteristics. J. J. WILKINS

537.542

8910. The parallel plate counter as a self-quenching particle measuring equipment. E. BAGGE AND J. CHRISTIANSEN. Note in *Naturwissenschaften*, **39**, 298 (*No.* 13, 1952) *In German.*

A spark counter used with a lower voltage was found to give very narrow pulses of up to 0·5 V. A plateau of about 100 V at 3000 V, with a slope of 0·05%/V was obtained. Particles less than 10^{-6} sec apart could be resolved, and a life of over 10^{10} counts was obtained. F. R. HOLT

537.542 : 621.318.572

8911. Pulse amplitude analysis in nuclear research. I. A. B. VAN RENNES. *Nucleonics*, **10**, 20–7 (*July*, 1952).

Methods of determining pulse amplitude distributions are outlined briefly. The requirements of voltage discriminators, particularly the need for rapid operation, are discussed and a number of types of discriminator including the biased diode, biased amplifier, Schmitt circuit and various modifications of the latter are described. L. R. SHEPHERD

537.542

8912. The behaviour of ions in a self-triggered Wilson chamber. H. DE LABOULAYE, C. TZARA AND J. STUDINOVSKI. *J. Phys. Radium*, **13**, 359–67 (*June*, 1952) *In French.*

The ions in a proportional counter were observed by constructing it (2 parallel wires and an α-source) inside a Wilson chamber triggered a selected time after the start of the discharge. Results are given as photographs and diagrams and are discussed. It was confirmed that the ions rapidly form stable aggregates with a mobility of about 0·9 cm^2/volt sec. An abnormal velocity of about 0·2 for some of the positive ions was observed when the collecting field was removed after the end of the expansion. This is explained as a thermodynamic effect. F. R. HOLT

537.543 : 621.385.16.029.6

8913. A statistical approach to the space-charge distribution in a cut-off magnetron. G. HOK. *J. Appl. Phys.*, **23**, 983–9 (*Sept.*, 1952).

When the anode potential of a non-oscillating magnetron is lower than the cut-off potential, the discrete

electron-to-electron interaction has an effect on the space-charge distribution which would be negligible if only resulting in flucutations about a known steady state. However, the states proposed by Brillouin, Slater and others are not steady states in this sense. The electron interaction must, therefore, be expected to produce a steady drift away from such initial states. This paper discusses qualitatively the final steady state to be expected and its dependence on the ratio of anode voltage to cut-off voltage. Because of the involved nature of the electron distribution function no attempt is made to calculate the space-charge distribution explicitly. A.

537.543 : 621.385.2.032.21

8914. An approximation of the formula for current saturation in diodes with tungsten cathodes. Z. DZHAKOV. *Zh. Tekh. Fiz.*, **22**, 602–5 (*No.* 4, 1952) *In Russian.*

Theoretical discussion of the relation between anode and filament currents and anode potential in the region of saturation, the cathode having unevenly distributed temperature. In support, experimentally obtained graphs give parameters of a diode and their dependence on the dimensions of the tungsten cathode and its temperature. Z. F. WOJNAR

IONIZATION . THERMIONICS 537.56/.58

537.56 : 551.510.41

A self-consistent calculation of the dissociation of oxygen in the upper atmosphere. *See Abstr.* 9224

537.562

8915. Mass-spectrometric investigation of SH_2, SeH_2, PH_3, SiH_4 and GeH_4. H. NEUERT AND H. CLASEN. *Z. Naturforsch.*, **7a**, 410–16 (*June*, 1952) *In German.*

The thresholds and relative ionization and dissociation yields were measured for electrons passing through the above gases. The dissociation probabilities increase with increasing mass of the molecules whereas the thresholds show a gradual decrease. W. J. SWIATECKI

537.563

8916. Some observations on the mass spectrum of CO_2. A. S. NEWTON. Letter in *J. Chem. Phys.*, **20**, 1330–1 (*Aug.*, 1952).

A small peak (O_2^+?) at mass 32 (~0·019% of the mass 44 peak) has been observed in the mass spectrum of purified CO_2. The 32/44 ratio is independent of sample pressure and carbonization tests eliminate the filament as a possible source. Tests with CO_2 enriched in O^{18} show that half of the oxygen certainly comes from the CO_2. An apparent discrepancy in the ratios 44/22 in $CO^{16}O^{16}$ and 46/23 in $CO^{16}O^{18}$ is also discussed, indicating that $(CO^{16}O^{18})^{++}$ has 8% less chance of formation than $(CO^{16}O^{16})^{++}$; probably the former has a greater fragmentation tendency. T. G. PICKAVANCE

537.568

8917. Charge transfer for protons in helium. R. H. GARSTANG. Letter in *Phys. Rev.*, **87**, 529–30 (*Aug.* 1, 1952).

The total cross-section for the capture of an electron from a helium atom in the ground state by low velocity protons was calculated by the method of perturbed stationary states, for the case of the capture into the 2*s* state of hydrogen. The results are presented graphically. J. HUGHES

537.571 : 537.531.08

Ionization of liquids by radiation. *See Abstr.* 8888

537.572 : 621.317.333 : 621.315.61

8918. Method for the detection of ionization processes in insulating materials. B. HELLER AND A. VEVERKA. *Elektrotech. Obz.*, **41**, 153–8 (*No.* 4, 1952) *In Czech.*

A method is described for detecting and measuring ionization in its initial stages before it can be reliably indicated by Schering bridge methods. The new method is based on the fact that the product of amplitude and frequency of the h.f. oscillations set up through the discharge bears a certain relation to the intensity of this discharge; this in turn can be expressed approximately by the first derivative of the current curve. Diagrams of connection and a detailed description of the measuring apparatus, and examples are given. J. H. NOREL (R)

537.583

8919. Activated electron emission from metal surfaces. R. SEELIGER. Note in *Naturwissenschaften*, **38**, 476 (*No.* 20, 1951) *In German.*

537.583 : 548.73

8920. A study of the oxide-coated cathodes by X-ray diffraction method. I. E. YAMAKA. *J. Appl. Phys.*, **23**, 937–40 (*Sept.*, 1952).

The relation between the crystal size of barium-strontium oxide and its thermionic emission was studied with the same vacuum tube. The crystal size was measured by an X-ray diffraction method. The measurements were made in vacuum by using thin mica windows as the entrance and exit ports for the X-ray beam. The emission was measured with pulse in order to avoid gas from the anode. Below 1050°C the crystal grows slowly, but above it crystal growth is rapid. It seemed that impurity activation is dominant at low temperatures, but heat activation is dominant at high temperatures. A.

537.583 : 621.385.032.216

8921. Activation of high vacuum oxide-cathode valves. G. H. METSON. *Vacuum*, **1**, 283–93 (*Oct.*, 1951).

The three current theories of activation of the oxide-coated cathode—chemical reduction, electrolysis and thermodynamic—are considered and discussed on the basis of the author's own laboratory experience. None of the theories are considered to give at present an adequate explanation of the high level of initial activation now common in oxide-cathode valves. A.

537.583 : 621.385.032.216

8922. Thermionic emitters under pulsed operation. R. LOOSJES, H. J. VINK AND C. G. J. JANSEN. *Philips Tech. Rev.*, **13**, 337–45 (*June*, 1952).

The potential gradient in the oxide coating of a cathode for pulsed operation was first investigated. This indicated that the layer with large resistance in the interface between nickel and oxide, often encountered by other investigators, was absent in the cathodes examined. It appears, however, that in the

case of some oxide-coated cathodes, such as (BaSr)O and SrO, a layer with large resistance occurs at the side nearest the anode, which results in a considerable increase in potential in the outer layer of the oxide coating. This, in turn, causes a large velocity spread of the emitted electrons which often amounts to hundreds of electron volts. By means of a specially constructed tube, the velocity spectrum was examined for different kinds of cathodes under different conditions. The spectrum, curiously enough, appeared to be discrete. The occurrence of the layer with large resistance, which results in the considerable velocity spread, is probably due to two mechanisms causing the conduction through the oxide coating: the pore conduction and the conduction of the grains of the oxide. The relative importance of the two conduction mechanisms will have a decisive influence on whether the layer of large resistance occurs or not. No satisfactory explanation has been given so far for the occurrence of discrete lines in a velocity spectrum. The considerable potential gradient in the outer layer of the oxide may well be one of the causes of the sparking observed with oxide cathodes under pulsed conditions. A.

COSMIC RAYS 537.591

537.591

8923. Balloons of plastic material fabricated by a new method. P. DEMERS AND J.-L. DE GRANDPRÉ. *Canad. J. Phys.*, **30**, 235–52 (*May*, 1952) *In French.*

Polythene sheets have been welded together by the use of an electrically heated wire in a special apparatus to make the very large balloons required for cosmic-ray research. An account is also given of the theoretical considerations necessary to determine the design of an efficient balloon. J. M. HOUGH

537.591.15

8924. On the theory of cascade showers. I. J. NISHIMURA AND K. KAMATA. *Progr. Theor. Phys.*, **7**, 185–92 (*Feb.*, 1952).

The improved mathematical treatment for the calculation of cascade theory is presented. The solution corresponding to a single incident electron derived by this method is identical with that of Snyder and Scott. The method is mainly due to the principle of analytic continuation but somewhat different from that of Bhabha–Chakrabarty. It is also applicable to other inhomogeneous integro-differential equations and in particular should be useful for further works on cascade theory. As an example, it is shown that the lateral and angular distribution functions are derivable analytically by this method. A.

537.591.15

8925. On the theory of the angular and lateral spread of the nucleon component of the cosmic radiation. H. S. GREEN AND H. MESSEL. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 689–701 (*Sept.*, 1952).

The three-dimensional development of the nucleon component of extensive air showers is investigated. A vectorial diffusion equation is derived for the phase-space distribution of the nucleons, and solved as far as required to determine the mean square angular deviation and the mean square distance from the shower axis. Account is taken of the variation of density in the atmosphere, and numerical results are obtained for all altitudes. These are exhibited graphically. The lateral spread of the nucleon cascade in Pb is also determined, and the results tabulated. A full discussion is given of the significance of the numerical values obtained. A.

537.591.5

8926. On the distribution of single tracks produced by cosmic rays in nuclear emulsions rotated about an axis pointing to the pole star and with a fixed orientation relative to the sun. M. MORAND AND S. DESPREZ-REBAUD. *C.R. Acad. Sci.* [*Paris*] **235**, 294–6 (*July* 28, 1952) *In French.*

The angular distribution has been determined for ~4000 tracks which are attributed to protons of energy <120 MeV and it is claimed that there is a minimum intensity in the direction of the sun.

H. ELLIOT

537.591.5

8927. The altitude variation of penetrating showers. A. L. HODSON. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 702–8 (*Sept.*, 1952).

The altitude variations of local penetrating showers and of extensive penetrating showers have been studied between sea level and 33 500 ft. The attenuation length in air of the radiation producing local penetrating showers is found to be (129 ± 2) g/cm^2. This value has been corrected for the effect of deviations of the radiation from vertical incidence on the apparatus. Local penetrating showers observed under a transition layer of Pb 10 cm thick are about 750 times more frequent at 33 500 ft and 500 times more frequent at 30 000 ft than at sea level. A.

537.591.8 : 537.534.9

8928. Ionization loss at relativistic velocities in nuclear emulsions. M. M. SHAPIRO AND B. STILLER. Letter in *Phys. Rev.*, **87**, 682–4 (*Aug.* 15, 1952).

Evidence for a relativistic rise in I, the rate of energy loss by ionization, has been found in 400μ Ilford G5 emulsions exposed to cosmic radiation at 100 000 ft. The grain density of tracks due to two groups of particles was measured, thin shower tracks and tracks due to incident shower-producing particles. The former tracks were used to determine g_{min}, the grain density corresponding to I_{min}, and the latter tracks were used to determine g_{pl}, the "plateau" grain density corresponding to Fermi's plateau value I_{pl}. The observed value of g_{pl}/g_{min} is 1·12 which is compared with the calculated value of I_{pl}/I_{min} of 1·14.

A. C. COATES

MAGNETISM 538

538.082 : 621.317.41

8929. Method of determining magnetic moments and for measuring susceptibilities and permeabilities. S. J. BARNETT. *J. Appl. Phys.*, **23**, 975–6 (*Sept.*, 1952).

Fundamentally, the method is closely related to one described by W. Weber in 1852 in his *Elektrodynamische Massbestimmungen* and applied by him to

the measurement of very small susceptibilities in cases in which it was desirable to exclude eddy currents from the specimens under examination. It is capable of being modified so as to measure magnetic moments and magnetic susceptibilities, large and small, under a great variety of conditions. The method has the advantage, for low permeabilities, over that of permeameters, that it measures precisely the (small) *difference* between the permeability of the specimen and that of air, and not the *ratio* of the two. It determines the magnetic moment of the specimen and the susceptibility k, from which the permeability μ may be derived from the relation $\mu = 1 + 4\pi k$. A.

538.12 : 621.3.013.78

8930. Cylindrical magnetic screens. M. Berti. *Elettrotecnica*, **39**, 246–51 (*May*, 1952) *In Italian.*

The method of conformal representation is applied to the study of the distribution of the magnetic flux on the external surface of a cylindrical screen introduced into a uniform field. An approximate expression can then be obtained for the field inside the screen for any magnetic material. The calculation is extended to the case of a screen formed by a number of ferromagnetic layers. Experiments to check the theory are also described. L. PINCHERLE

538.221

8931. On the antiferromagnetism of $CuCl_2 2H_2O$ single crystal. K. Yosida. *Progr. Theor. Phys.*, **7**, 25–38 (*Jan.*, 1952).

A theory of the antiferromagnetism of $CuCl_2 2H_2O$ single crystal is developed, based on the Van Vleck model modified by the introduction of the anisotropic spin-spin coupling besides the usual isotropic exchange coupling. Since the spin quantum number S of the magnetic Cu^{2+} ion in this substance is 1/2, the effect of the crystalline electric field can only be taken into account by adopting an adequate tensor form for the Landé g-factor. Starting from this point of view, formulae for the anisotropy of the susceptibility, both above and below the Curie point and for the temperature variation of the anisotropy constant are derived. The critical field discovered by C. J. Gorter *et al.* [Abstr. 6346 (1951)] and the antiferromagnetic resonance frequency are also discussed. A.

538.221

8932. Microwave resonance in ferrimagnetic substance. N. Tsuya. Letter in *Progr. Theor. Phys.*, **7**, 263–4 (*Feb.*, 1952).

Obtains a theoretical relation giving the resonance condition and effective g values. Application to the dependence on composition of the g values of mixed NiZn ferrites. E. P. WOHLFARTH

538.221 : 621.318.1

8933. Some applications of ferroxcube. W. Six. *Philips Tech. Rev.*, **13**, 301–11 (*May*, 1952); *Electronic Appl. Bull.*, **13**, 44–57 (*March–April*, 1952).

Following a discussion of the characteristics of magnetic circuits with air gaps the paper describes some coils wound on ferroxcube cores. These include filter and loading coils for telephone circuits, for which the "pot" type of core is preferred, wide-band h.f. transformers using cores made up of two E blocks with mating faces ground to give the smallest possible air gap, and an i.f. transformer in which adjustable ferroxcube rod cores are used. A feature of this coil is the magnetic screening by 3 ferroxcube rods placed around the coil parallel to its axis. Their high permeability causes a large part of the field to be concentrated in these rods, and because of their high resistivity the eddy current losses in them are small. W. G. STRIPP (R)

538.222

8934. Theory of some magnetic properties of cobalt Tutton salts. K. Kambe, S. Koide and T. Usui. *Progr. Theor. Phys.*, **7**, 15–24 (*Jan.*, 1952).

The g-values in the paramagnetic resonance experiment and the static magnetic susceptibilities of the cobalt Tutton salts are calculated under the assumption that the crystalline field is nearly cubic with a small tetragonal component. The values of these quantities depend on the value of a parameter $\eta = 4\delta/3\lambda$, where δ is the energy separation between the lowest energy levels when the spin-orbit coupling is disregarded, and λ is the spin-orbit coupling constant. Comparing the theoretical results with the experimental data, it has been estimated that $\eta = 3{\cdot}5 \sim 4{\cdot}5$ from g-values, $\eta = 4 \sim 5$ from $\chi_\perp$, but the measured values of $\chi_{||}$ do not fall between the theoretical curves of $\chi_{||}$ verses T with $\eta = 4$ and 5. This discrepancy is discussed. A.

538.222

8935. Magnetic susceptibility of mixed crystals of potash and chrome alums. V. D. P. Sastri. Letter in *Curr. Sci.*, **21**, 96–7 (*April*, 1952).

Reports room temperature measurements. The observed susceptibility values are in excess of those calculated on the basis of a linear dependence on composition, due, possibly, to a partial unquenching of the orbital moment in the paramagnetic Cr alum by the addition of diamagnetic K alum. E. P. WOHLFARTH

538.222

8936. The cupric ion in a trigonal crystalline electric field. B. Bleaney and K. D. Bowers. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 667–8 (*Aug.*, 1952).

There is a reversible change in the paramagnetic resonance spectrum at low temperatures, the spectrum becoming complex and anisotropic. Results indicate that at low temperatures the rapidly fluctuating distortions associated with the Jahn–Teller effect (1937) are replaced by static distortions. L. PINCHERLE

538.222

8937. The spin-Hamiltonian and line widths in nickel Tutton salts. K. W. H. Stevens. *Proc. Roy. Soc. A*, **214**, 237–46 (*Aug.* 21, 1952).

An account is given of the derivation and properties of a spin-Hamiltonian which has recently [Abstr. 7401 (1952)] been used to describe the results of magnetic resonance experiments on Ni Tutton salts. It is obtained on the assumption that the Ni ions are situated in a field of rhombic symmetry. A theory of line widths is then developed and a comparison is made with experimental results obtained for Ni ammonium selenate. Agreement is only obtained if it is assumed that in addition to dipolar couplings between the ions there are exchange interactions of comparable magnitudes. The sign of the exchange is

found to be that associated with ferromagnetism and its magnitude is of order $0{\cdot}025\ cm^{-1}$. A.

538.222

8938. A note on the detection of free radicals by means of paramagnetic resonance absorption. Biradicals. C. A. HUTCHISON, JR, A. KOWALSKY, R. C. PASTOR AND G. W. WHELAND. *J. Chem. Phys.* **20,** 1485–6 (*Sept.*, 1952).

The application of paramagnetic resonance absorption to the detection of organic free radicals is discussed. The advantages of this method over conventional measurements of magnetic susceptibility are illustrated by the results of measurements on *p, p'*-biphenylene-*bis*-(diphenylmethyl). A.

538.222

8939. Anomalous paramagnetism of copper acetate. B. BLEANEY AND K. D. BOWERS. *Proc. Roy. Soc. A.*, **214,** 451–65 (*Oct.* 9, 1952).

The paramagnetic resonance spectrum of Cu acetate is anomalous in that it resembles that of an ion of spin 1, and its intensity decreases as the temperature is lowered. The latter is correlated with the decreasing susceptibility found by Guha (1951). The following hypotheses are suggested: (1) the crystalline field acting on each Cu ion is similar to that in other salts such as the Tutton salts; (2) isolated pairs of Cu ions interact strongly through exchange forces, each pair forming a lower singlet state and an upper triplet state, the latter only being paramagnetic. On this basis both the fine structure and the hyperfine structure of the spectrum have a simple explanation, and the theory also predicts a small initial splitting of the triplet state of the same order as that found experimentally. The unit cell of the crystal contains two differently oriented pairs of ions, and, using an empirical value for the exchange parameter, fair agreement with the susceptibility measurements of Guha is obtained. A.

538.222

8940. Nuclear magnetic resonance in metals. I. Broadening of absorption lines by spin-lattice interactions. H. S. GUTOWSKY AND B. R. MCGARVEY. *J. Chem. Phys.*, **20,** 1472–7 (*Sept.*, 1952).

Magnetic resonance line shapes and widths, their temperature dependence and the conduction electron shifts in resonance frequency are reported for the metals Li^7, Na^{23}, Al^{27}, Cu^{63}, Cu^{65}, Ga^{69}, Ga^{71}, Rb^{85}, Rb^{87} and Cs^{133}. The absorption lines in most of these metals are broader than predicted for nuclear magnetic dipolar broadening alone. It is proposed that the mechanism responsible for most, if not all, of this additional broadening is the interaction between the nuclear spins and the conduction electrons, which also determines the spin-lattice relaxation time. Spin-lattice relaxation times T_1 are estimated from the nondipolar broadening of the experimental absorption lines. These T_1 values compare favourably with available directly measured values and with approximate T_1 values obtained by Korringa's theory from the measured resonance shifts. In the case of Li, a dipolar line-width transition was observed at 255°K; this transition results from self-diffusion, for which an activation energy of $9{\cdot}8 \pm 1$ kcal/mole is determined. A.

538.222

8941. A bridged tee detector for nuclear magnetic resonance. C. E. WARING, R. H. SPENCER AND R. L. CUSTER. *Rev. Sci. Instrum.*, **23,** 497–8 (*Sept.*, 1952).

The circuit of a bridged tee network for the measurement of nuclear magnetic resonance is described. This circuit was used to measure the field strength of a large air core solenoid. The balance equations for the bridged tee network are: $W^2 = 1/L[C_1C_2/(C_1 + C_2)]$, $R = [L/(C_1 + C_2)]r$. The probe contained one ml of No. 20 lubricating oil with B and S No. 17 copper wire wound directly on the proton sample cell to give convenient resonance capacities and a convenient resonant impedance (500 to 25 000 ohms) near the 20 Mc/s working frequency. The simplicity of construction, the general utility and the adaptability to ordinary laboratory apparatus prove the circuit to be excellent for detecting nuclear magnetic resonance. A.

538.222 : 539.152.1 : 548.7

Interaction of the nuclear spin with oscillations of the crystal lattice. *See Abstr.* 9159

538.224

8942. The diamagnetic susceptibilities of ions. M. PRASAD AND C. R. KANEKAR. *J. Sci. Industr. Res.* **11A,** 183–96 (*May*, 1952).

A review of the following topics: theoretical calculations, deduction of ionic susceptibility values from measurements on salts (Pascal's law, use of standard values), tabular comparison between theory and experiment, graphical methods for evaluating susceptibilities from measurements, calculation of ionic radii [see also Abstr. 5906 (1952)].

E. P. WOHLFARTH

538.23

8943. Magnetic viscosity under discontinuously and continuously variable field conditions. R. STREET, J. C. WOOLLEY AND P. B. SMITH. *Proc. Phys. Soc.* [*Lond.*] *B*, **65,** 679–96 (*Sept.*, 1952).

For a ferromagnetic specimen exhibiting magnetic viscosity, the intensity of magnetization increases continuously with time under steady external field conditions. An account is given here of investigations to determine the influence on magnetic viscosity of changes in the magnetic field applied to the specimen, two cases of discontinuous and continuous changes in field being considered. The latter case is of practical importance when direct measurements of magnetic viscosity are made using specimens with demagnetization coefficient other than zero since the effective field acting in the specimen is then continuously variable in time. It is found that both cases can be adequately described by extending the previously proposed [Abstr. 384, 7356 (1950)] formal theory of magnetic viscosity in which it was supposed that the domain processes responsible for magnetization can be activated by thermal agitation. The required extension of the theory consists in assuming that the activation energy of the domains is a function of the field. The experimental results show that the changes in domain activation energy are linearly proportional to the changes in field strength, if the latter are small. Denoting the constant of proportionality by q, and considering a possible domain model, it is shown that

q is related to the elementary volume of the material in which thermal agitation leads to activation. Measurements on Alnico show that the linear dimensions of this elementary volume are of the same magnitude as the width of a domain boundary wall. Results of the variation of q and other parameters characteristic of magnetic viscosity as functions of the temperature of the specimen are also presented and it is shown that the observed behaviour is consistent with the present views on the metallurgical structure of Alnico. A.

538.24 : 536.48

8944. Magnetic properties of mercury at low temperatures. B. I. Verkin, B. G. Lazarev and N. S. Rudenko. *Dokl. Akad. Nauk SSSR*, **80**, 45–6 (*No.* 1, 1951) *In Russian.*

The de Haas–van Alphen effect has been found in a mercury single crystal at 1·84°K and lower temperatures at fields of about 14 000 gauss; the amplitude at these fields is however negligible at 4·2°K. D. SHOENBERG

ELECTROMAGNETISM . ELECTRODYNAMICS
538.3/.5

538.3

8945. The energy momentum tensor in Dirac's new electromagnetic theory. S. F. B. Tyabji. Letter in *Nature* [*Lond.*] **170**, 116 (*July* 19, 1952).

The non-symmetrical tensor, derived from Dirac's Lagrangian [Abstr. 5092 (1952)] which allows vortical streams of charge, is made symmetrical by the addition of suitable terms and has the same form as the energy-momentum tensor of the irrotational theory. R. A. NEWING

538.3 : 532.517

8946. On the magnetic effects of turbulence in ionized gases. I. K. Csada. *Acta Phys. Hungarica*, **1**, 235–46 (*No.* 3, 1952).

In gases which are good electric conductors (ionized gases) local magnetic fields can rise spontaneously by turbulence. These fields may be produced by the diffusion of electrons due to fluctuating temperature. Batchelor's stability criteria show that highly ionized gases are unstable to magnetic disturbances at temperatures above 10 000°C. On the analogy between vorticity and magnetic field the effects produced in perfect conducting gases may be estimated, making use of the vorticity transport hypothesis. It may be inferred that the specific conductivity of the gas decreases by some orders of magnitude and the magnetic permeability increases. This agrees with the investigations of Sweet, who has similarly come to this conclusion. A necessary condition is given by this theory for the origin of the permanent magnetic field of the stars derived from the high ionization and turbulence. By introducing new functions the equations of electromagnetic hydrodynamics may be written in symmetrical form analogous to the equations of motions in classical hydrodynamics. The equations also remain analogous in the case of homogeneous isotropic turbulence. A.

538.3 : 537.312.62

8947. On Planck's formulation of the law of the inertia of energy. F. Beck. Note in *Naturwissenschaften*, **39**, 254–5 (*No.* 11, 1952) *In German.*

The stress energy tensor is taken to be such that $T_{k4} = icg_k$, $T_{4k} = (i/c)S_k$, $k = 1, 2, 3$, where $\boldsymbol{S}$ is the energy flow vector and $\boldsymbol{g}$ the momentum density. The law $g = S/c^2$ then follows only for symmetrical $T_{\mu\nu}$. The possibility of symmetrizing the tensors occurring in the electrodynamics of moving media [Abstr. 830 (1951)] and in the theory of superconductors [Abstr. 6507 (1950)] is discussed. R. A. NEWING

538.311

8948. A method of calculation of the magnetic field [inside conducting media]. B. Berkeš. *Glasn. Mat.-fiz. Astron.*, **7**, 36–47 (*No.* 1, 1952) *In German.*

Derives the formula $4\pi\boldsymbol{H} = \int_S r^{-1} \operatorname{curl} \boldsymbol{J} d\boldsymbol{S}$, where $\boldsymbol{H}$ is the field inside the conductor and $\boldsymbol{J}$ the current density, the integration being over the surface of the conductor. The formula is applied to a long straight circular cylinder, an infinite thin plate and a square and circular annulus. E. P. WOHLFARTH

538.5 : 551.594

8949. An electromagnetic interpretation problem for the sphere. L. B. Slichter. *Proc. Roy. Soc. A*, **214**, 356–70 (*Sept.* 23, 1952).

Within an isotropic sphere, the three electrical properties of material are assumed to vary in an unknown manner as functions of the radial distance only. The sphere is subjected to a symmetrical harmonic inducing field from an external source. From observations of the magnetic vector on the surface of the sphere, the variation of its electrical properties is determined in the form of Taylor's series. The variations of the magnetic permeability and dielectric constant are determined from observations at two frequencies; the conductivity function, however, may be found by use of a single frequency. The solutions are checked algebraically by comparison with known results for two special cases. It is shown that the horizontal and vertical components of the magnetic vector are mutually dependent. A simple reciprocal relationship which is formally independent of the electrical properties of the sphere exists between the distribution of the magnetic intensity and that of the source currents. The converse problem of determining the unknown electrical properties of the exterior region when those of the sphere are known is also discussed. This problem is an idealized version of the problem of determining the electrical properties of the high atmosphere. A.

538.51 : 621.3.011

8950. Vector potential derivation from scalar potentials. J. J. Smith. *Elect. Engng* [*N.Y.*] **71**, 802 (*Sept.*, 1952). Digest of *Amer. Inst. Elect. Engrs, Paper* **52–129** to be published in *Trans* **71** (1952).

Three definitions of vector potential are compared and the relations between scalar and vector potential are derived when there is no variation with time. Two different vector potentials may give rise to the same value of flux density. It is shown how one such

vector potential may be converted into the other. Scalar and vector potentials are derived for a point source, a rectangular and a circular coil, and a thin rectangular and a thin circular disk of magnetic material. A. J. SMALL (R)

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 621.3.011

8951. On the first boundary-value problem of Maxwell's equations. E. LEDINEGG AND P. URBAN. *Ann. Phys.* [*Lpz.*] **10,** 349–60 (*No.* 6–7, 1952) *In German.*

Oscillatory e.m. systems confined within a certain volume may be of two kinds, those excited from within and those from without. The former are characterized by a non-homogeneous differential equation with homogeneous boundary requirements while in the latter case the equation is homogeneous and the boundary conditions not. The second case is of practical importance at cm-wavelengths and is the special study here. The solution is presented in vectorial and integral equation form and also in coordinates for practical application. S. C. DUNN (R)

538.561

8952. The proper e.m. oscillations of a parallelepipedal cavity with walls of finite conductivity. R. MÜLLER AND E. RUCH. *Z. angew. Phys.*, **4,** 254–8 (*No.* 7, 1952) *In German.*

These consist of suitable linear combinations of *E*- and *H*-waves of the same order. The determination of the coefficients is reduced to a geometrical problem. L. PINCHERLE

538.565

8953. Surface losses in electromagnetic cavity resonators. I. PAGHIS. *Canad. J. Phys.*, **30,** 174–84 (*May*, 1952).

The effective skin resistance of brass has been determined at microwave frequencies, by means of Q measurements. Refinements have allowed the Q measurement to be made with an accuracy of the order of 0·3% over a wide frequency range. The measured values are in essential agreement with theoretical prediction, provided that surface treatment is confined to slow hand polishing. This agreement holds for relaxation calculations on re-entrant type resonators, as well as for rigorously soluble resonators. An attempt has been made to correlate the surface roughness of a resonator with the effective skin resistance. The results obtained are in agreement with theoretical work. The effect of surface scratches is small when compared with the effect of a distortion in the crystal lattice at the surface of the brass, due to surface work. The perturbation of the field distribution of the normal modes by wall losses is usually assumed to be negligible. A calculation by the relaxation method shows that, for the best conductors at room temperatures, the perturbation of the normal modes may become serious at millimeter wavelengths. A.

538.565 : 537.525.92 : 621.396.611.4 : 621.317.336

8954. Methods of measuring the properties of ionized gases at high frequencies. III. Measurement of discharge admittance and electron density. D. J. ROSE AND S. C. BROWN. *J. Appl. Phys.*, **23,** 1028–32 (*Sept.*, 1952).

For Pts I–II, see Abstr. 8340–1 (1952). Experimental methods are given for determining the complex admittance and electron density of gas discharges by the use of microwave techniques. Applications are discussed where the discharge is contained in either high or low Q resonant cavities. A.

538.566

8955. On the concept of group velocity. P. POINCELOT. *C.R. Acad. Sci.* [*Paris*] **234,** 2426–7 (*June* 16, 1952) *In French.*

The steady state regime of a sinusoidal wave train in a medium of refractive index $n = (1 - a^2/\omega^2)^{\frac{1}{2}}$, propagates rigorously with the group velocity [Abstr. 3730 (1952)]. It is shown that a wave train propagating from a medium of refractive index 1 to a medium of refractive index n is refracted immediately with an index of refraction corresponding to the steady state regime. G. D. SIMS

538.566 : 621.392.26

8956. The excitation of a circular waveguide. G. T. MARKOV. *Zh. Tekh. Fiz.*, **22,** 747–58 (*No.* 4, 1952) *In Russian.*

A mathematical treatment is developed of the problem of cylindrical e.m. waves [Japolsky, *Phil. Mag.*, **19,** 934–58 (1935)] with reference to its application to the analysis of the internal and external field of an infinitely long circular waveguide. The general formulae derived in the paper embrace a number of particular problems, e.g. the diffraction in the vicinity of the guide, the influence of the slits on its surface, the action of metal aerials in its vicinity, etc. These general formulae also embrace the solutions regarding the radiations from longitudinal and transversal slits in a cylinder which were obtained by A. A. Pistoljkors [*Zh. Tekh. Fis.*, **17,** 365, 377 (1947)] and M. L. Levin (*ibid.*, **21,** 772 (1951)]. References are given to alternative methods used for the solution of the problem of the excitation of a cylindrical (or "circular") waveguide from inside. offered by G. V. Kisunko [*Zh. Tekh. Fis.*, **16,** 565 (1946)] and A. A. Samarsky and A. N. Tikhonov [*Zh. Tekh. Fis.*, **17,** 1283, 1431 (1947)]. The analysis is based on the Maxwell equations supplemented by the terms expressing the volume distribution of the "exciting" currents from the external sources. These equations, initially set in the vectorial form (but assuming the sinusoidal time function from the start) are then converted into analytical form with reference to cylindrical co-ordinates, and with the use of the vector and scalar potentials which are substituted for the field components. The solution is then given in terms of the second Hankel functions H_n and first Bessel functions J_n with the aid of the Green function G thereof, which takes the form of an infinite series of harmonics of rotating waves with different number of circular waves n with the local amplitudes representing integrals from $-\infty$ to ∞ with respect to the variable decrement of an exponential function of the axial co-ordinate, the integrands of which represent the

products H_nJ_n and this exponential function. The validity of the solutions in this form is proved on the basis of the fundamental properties of the Bessel and the Hankel functions, and it is also shown how with the aid of this form of expression for the solutions, the current densities can be expressed in the form of the Fourier–Bessel integral and Fourier series. The application of these results to e.m. waves produced by external currents (*a*) in an unrestricted space, (*b*) in a circular waveguide excited from externally situated sources and (*c*) in a circular waveguide excited from an internally situated source, is considered in separate sections. N. S. JAPOLSKY

538.566 : 621.392.26

8957. On the calculations of the excitation of waveguides. L. S. BENENSON. *Zh. Tekh. Fiz.*, **22**, 559–78 (*No.* 4, 1952) *In Russian.*

The calculation of the excitation of a waveguide by vibrators in it, and by slits in its walls, can be divided into two main parts: (1) a determination of the fields excited in the waveguides by the given current distribution in the vibrators and field-strength distribution in the slits, and (2) a determination of those components of these currents and field-strengths which result from the waves propagated in the guides. The first problem, for the regions not too close to the sources of radiation, can be conveniently treated by using the superposition of partial waves, with the application of Lorentz's lemma [Ya. N. Feld, *Zh. Tekh. Fis.*, **17**, 1471 (*No.* 12, 1947) and M. B. Zakson, *Dokl. Akad. Nauk SSSR*, **66**, 637 (*No.* 4, 1949)] or the "conjugate lemma" [Ya. N. Feld, *Dokl. Akad. Nauk SSSR*, **61**, 481 (*No.* 5, 1947)] which is more suitable in a number of cases. The second problem generally requires a solution of a system of integro-differential equations, which can be reduced, however, to the linear algebraic equations with respect to the amplitudes of the currents and field-strengths in those cases where the distribution of the currents in each vibrator and field-strengths in each slit can be specified independently of the rest of the vibrators and slits [Ya. N. Feld, *Zh. Tekh. Fiz.*, **68**, 1265 (*No.* 10, 1948)]. The object of the present paper is to extend this method, which Feld applied to waveguides with slits, to waveguides containing vibrators also, to derive formulae for computing the coefficients in these equations (i.e. the induced conductivities) and to solve an auxilary problem—the excitation of a waveguide loaded at both ends. By the "conjugate lemma" the author apparently means the application of the Poynting theorem to the case where an e.m. field outside an enclosed volume is excited by electrical currents within it, and where the currents and the field are assumed to be resolvable into sinusoidal harmonics. The energy flux density is expressible as a sum of vector products of the complex amplitudes of the electric field by the conjugate complex amplitudes of the magnetic field, and *vice versa*, while the power per unit volume is expressible as a sum of scalar products of complex amplitudes of current densities by the conjugate complex amplitudes of field strengths. This treatment allows the conceptions of eigenfunctions and the eigenvalues to be applied to the problem. The analysis is restricted to the case where the harmonics can be assumed to be mutually independent. This method leads to the conversion of differential or integral equations into equations between finite quantities. The procedure is shortened by a specific system of notation. A number of particular problems of waveguides with slits and vibrators of different shapes is treated. The application of the method is illustrated by a number of numerical examples with tables and charts.

N. S. JAPOLSKY

538.566 : 621.396.671 : 621.392.26

8958. Some properties of the propagation of waves in a conical horn. H. BUCHHOLZ. *Arch. Elektrotech.*, **40**, 346–62 (*No.* 6, 1952) *In German.*

Phase velocity, energy flow and energy density for any arbitrary partial wave are worked out by standard methods. The usual formula for the group velocity breaks down near the vertex ($2\pi r/\lambda < 1$). A definition is given for the velocity of propagation of the energy starting from energy density and energy flow: this may be used for all values of r/λ and coincides with the usual expression for $r \gg \lambda$. The waves are damped even for infinite conductivity of the walls; the physical reasons for this feature are brought out. L. PINCHERLE

538.566 : 621.396.671

8959. Reflection of microwaves from metal-plate media. J. J. BRADY, M. D. PEARSON AND S. R. PEOPLES. *J. Appl. Phys.*, **23**, 964–75 (*Sept.*, 1952).

The theory of Carlson and Heins and the extended theory of Lengyel has been verified experimentally for oblique angles of incidence. Both single surface and slab measurements were performed in the 3 cm band. Single surface measurements were made by using tapered wooden wedges as absorbing materials to eliminate back surface reflections. The effect of plate thickness was studied for five different thicknesses. The phase and amplitude of the reflection coefficient of a metal-plate slab were obtained for three angles of incidence, 10°, 25° and 35°, and for values of $2a/\lambda$ ranging from 1·10 to 1·30. A.

538.566 : 621.392.26

8960. On the calculation of the dispersion of waveguide filters with "slit" couplings. G. H. RAPOPORT. *Zh. Tekh. Fiz.*, **21**, 1076–86 (*No.* 9, 1951) *In Russian.*

The article relates to filters in the form of tubular waveguides divided in length by thin metal partitions with co-axial annular slits. The waves are assumed to follow the general pattern of non-rotating magneto-polarized cylindrical waves [N. S. Japolsky, *Phil. Mag.*, **19**, 934–58 (*May*, 1935)] which are also called "*E*-waves" or "transverse magnetic" waves and which, following the example of some of the reference books, the author prefers to denote as "TM_{opn}" waves. In these waves the magnetic lines of force are co-axial circles. The elementary solutions are expressed as products of a sinusoidal function of the axial co-ordinate and of Bessel functions of the first kind of the radial co-ordinate. The Bessel functions are of order 0 ($J_0(\ )$) for the axial component of electric field and they are of order 1 for other components. In order to satisfy the boundary conditions the radius of the tube must correspond to a root of J_0 and the axial wavelength must be a submultiple of the length of the given compartment of the waveguide. In the suffix at "*TM*," *o*, *p* and *n*, stand for

the order number of the Bessel function, the order number of its root, and the number of the waves on the length of the compartment, resp. The whole system of waves is regarded as consisting of two components: that which corresponds to the closed slits and that which is excited by the waves penetrating through the slits. The solution is sought in the form of an infinite double series of harmonics with respect to p and n. The connection between these two components is introduced in the form of the "coefficient of excitation" taken from the corresponding textbooks without an explicit verification of the applicability of the expression for this coefficient to the present system. A series of equations connecting the waves in different compartments is then obtained by introducing the continuity conditions at the slits and assuming a constant phase difference between the adjacent compartments. These equations yield the dispersion properties of the filter in a rather complicated form. It is shown, however, how to interprete these equations in the form of a definite spectrum, particularly in the neighbourhood of the resonance frequencies. This is illustrated by dispersion charts. N. S. JAPOLSKY

538.566 : 621.392.26

8961. Radiation from a dielectric wave guide. R. M. WHITMER. *J. Appl. Phys.*, **23**, 949–53 (*Sept.*, 1952).

The radiation from an infinite dielectric slab fed by a line source has been calculated from a branch-cut integral. The modal efficiency of the device as a waveguide is defined as the ratio of the power propagated in a mode to the sum of the modal and radiated powers. For a range of the parameters such that only one mode can be propagated, the modal efficiency has been plotted numerically. Except for extreme values of the parameters the efficiency runs around 80% to 90%. The slab form is not one likely to be used in practice, but the efficiency of a cylinder would be expected to have about the same value. A.

538.566.2 : 621.396.11

8962. On a simplified theory of electromagnetic wave diffraction by a mountain or a mountain-chain (Abstract). T. SOEJIMA. *Mem. Fac. Sci. Engng Waseda Univ.*, *No.* 14, 70–1 (1950).

A mountain is considered as a perfectly conducting solid upon a conducting plane earth. For certain simple shapes the diffraction can be determined by consideration of the source and mountain together with their images in the earth plane, the plane itself then being neglected. W. T. BLACKBAND (R)

538.566.3

8963. Analysis of observed absorption variations of electromagnetic waves in the ionosphere. G. LANGE-HESSE. Note in *Naturwissenschaften*, **39**, 297–8 (*No.* 13, 1952) *In German.*

Note on the outstanding differences in the behaviour of absorption of e.m. waves in the equatorial, mean and polar latitudes. Z. F. WOJNAR

538.566.3 : 551.510.535 : 621.396.11

8964. Oblique incidence pulse observation of the ionosphere near the maximum usable frequency. Y. V. SOMAYAJULU. Letter in *Curr. Sci.*, **21**, 155–6 (*June*, 1952).

Results of pulse observations made in India on 21·7 Mc/s over a distance of 1500 km during Feb. 1952. Reception was by single reflection at the $F2$-layer. Periodic fading between the two unresolved magneto-ionic components (Appleton–Beynon fading) was observed when the extraordinary ray was not absorbed and when the ordinary ray did not penetrate the $F2$-layer. G. M. BROWN

538.566.3 : 621.396.11

8965. Equivalent paths of the extraordinary waves for oblique incidence at the ionosphere. S. S. BANERJEE AND R. R. MEHROTRA. *J. Sci. Industr. Res.*, **11B**, 216–18 (*June*, 1952).

An expression for the equivalent path at oblique incidence in terms of the critical frequency and the thickness of the ionic layer is derived and found useful in interpreting fading patterns near the critical frequency. G. D. SIMS (R)

538.566.3 : 621.396.11

8966. On the theory of the interaction of radiowaves in the ionosphere. G. COLONNESE. *Elettrotecnica*, **39**, 200–4 (*No.* 4, 1952) *In Italian.*

A review of the theory of ionospheric cross-modulation as formulated by Ratcliffe and Huxley. The theory was verified by experiments carried out in Italy over a period of two years by the method of frequency exploration. L. PINCHERLE

MAGNETIC EFFECTS 538.6

538.613

8967. Faraday effect of paramagnetic ions in aqueous solutions. A. OKAZAKI. *Mem. Fac. Sci. Kyusyu Univ. B*, **1**, 15–18 (*March*, 1951).

The magnetic rotation constants of $CoSO_4$, $CoCl_2$, $Co(NO_3)_2$, $NiSO_4$ and $Fe(NO_3)_3$ in aqueous solution for D-lines are estimated using the results of other authors. G. I. W. LLEWELYN

538.69 : 532.517

Experiments on non-laminar flow of mercury in presence of a magnetic field. *See Abstr.* 8719

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

8968. A new method for calculating the energy levels of electrons in solids. Z. MATYÁŠ. *Czechoslovak J. Phys.*, **1**, 3–9 (*No.* 1, 1952).

The method described starts from the assumption that each valency electron in a crystal is subjected to the following potential: inside the atomic sphere

surrounding each atom this potential is spherically symmetrical while outside this sphere it is constant. The corresponding Schrödinger equation is solved by means of the perturbation theory with the help of certain approximate wave functions. The parameters determining the spherically symmetrical potential inside the sphere are determined from the values of energy for the lowest energy level, calculated by statistical methods. A.

539.11

8969. On the theory of the noble and alkali metals. P. Gombás. *Acta Phys. Hungarica*, **1**, 301–16 (*No.* 3, 1952) *In German.*

Continuation of previous work by the author which was in good agreement with experience for the alkali metals and the metals of the alkaline earths, but in far less satisfactory agreement for the metals Cu, Ag, Au, Zn, Cd, Hg. The theory is now improved, and yields satisfactory agreement with experiment, by determining a better equivalent potential in which the valence electrons are supposed to move. P. T. LANDSBERG

539.11

8970. Dipole-dipole interaction in simple lattices. T. H. Berlin and J. S. Thomsen. *J. Chem. Phys.*, **20**, 1368–74 (*Sept.*, 1952).

A mathematical model, the spherical model, of electric dipole-dipole interaction in simple lattices is discussed. The partition function for the system, assuming just nearest neighbour interaction, is evaluated for one- and three-dimensional simple lattices. Only the three-dimensional lattice exhibits a phase transition. The transition is discussed. The transition behaviour in the presence of an external field is also analysed, and the electric susceptibility is computed. A.

539.11

8971. Dipoles on a lattice: the spherical model. M. Lax. *J. Chem. Phys.*, **20**, 1351–9 (*Sept.*, 1952).

The statistical treatment of a lattice of classical dipoles, electric or magnetic, has been intractable because of the "strong" condition that all dipoles have a fixed length. The spherical model consists in replacing the above strong condition by the weaker condition that the sum of the squares of the dipole vectors have the correct value, thus permitting some, but not much, fluctuation from the true situation. The previous work of Berlin and Thomsen (preceding abstract) using the spherical model and nearest neighbour interactions is generalized to include a mixture of long and short range interactions. The evaluation of the partition sum in the presence of long range forces requires care because some of the eigenvalues depend on specimen shape. A formula has been derived for the susceptibility, however, in which the shape dependence is explicitly shown to cancel. In fact, it is proved that in the spherical model a permanent dipole lattice is equivalent to an induced dipole lattice with a certain effective polarizability. Expansion of this polarizability in inverse powers of the temperature shows precise agreement to terms of order $(1/T)^3$ with an exact evaluation of the corresponding expansion coefficients. All qualitative results are in agreement with those of Berlin and Thomsen. One- and two-dimensional lattices show no transition. A simple cubic lattice (the case they treat) shows an antiferroelectric transition bounded by a critical field curve $E = E_c[1 - (T/T_c)]^{\frac{1}{2}}$. The effective field, and its application to an elementary quantum mechanical treatment of the ferromagnetic problem, is described. A.

539.11

8972. An application of the cellular method to silicon. D. K. Holmes. *Phys. Rev.*, **87**, 782–4 (*Sept.* 1, 1952).

The calculations of Kimball (1935) and Mullaney (1944) applying the cellular method to elemental Si are extended to a higher approximation. Although the energy gap is decreased through use of a larger number of harmonics, the values obtained are still much higher than that given by experiment. The proposal of Pearson, Haynes and Shockley [Abstr. 6496 (1950)] that the highest point of the filled band and the lowest point of the conduction band do not occur at the centre of the zone may have a bearing on the results, since the calculations reported here are performed for zero wave number. The effective mass of the conduction electrons is determined under the assumption that the lowest point lies at the centre of the zone. A.

539.11 : 537.228.4

8973. The problem of the zero point energy [of molecules and crystals]. T. Neugebauer. *Acta Phys. Hungarica*, **1**, 167–73 (*No.* 2, 1951) *In German.*

A discussion of experimental verifications of the presence of zero point vibrations and of the problem whether these correspond to an actual oscillatory motion of atoms or merely to a "smearing out" effect. It is suggested that investigations of the Kerr effect in methane may be decisive in answering this problem. It is shown that the large value of the Kerr constant is not due to the anisotropy of the molecule but arises as a result of the Voigt effect. The measurements can thus not be taken as a verification of an actual oscillatory motion of atoms at absolute zero.

E. P. WOHLFARTH

MOLECULAR STRUCTURE 539.13

539.13

8974. Variation of the molecular optical anisotropy with physical state (gas, liquids and solutions, crystals). A. Rousset and R. Lochet. *J. Phys. Radium*, **13**, 289–93 (*May*, 1952) *In French.*

The intermolecular field theory of Raman and Krishnan explains the diminution of anisotropy on passing from the gas to the pure liquid (and solution). The molecular anisotropy (where A and B are the principal molecular refractivities) $\delta^2 = \frac{1}{2}\Sigma(A-B)^2/(\Sigma A)^2$, of solutions of (*a*) nitrobenzene and (*b*) benzene, in CCl_4 has been measured over the entire concentration range, and the results are discussed. The relative values of δ^2 for the ions NO_3^-, CO_3^-, ClO_3^-, BrO_3^-, IO_3^-, in crystals and in solution are interpreted.

G. I. W. LLEWELYN

539.132

8975. Radial matrix element for the quadrupole transition with the Morse potential. H. A. Buckmaster. *Canad. J. Phys.*, **30**, 314–16 (*July*, 1952).

A general formula for the radial part of the matrix element for the quadrupole transition with the Morse potential is derived using standard methods of analysis. The same methods can also be used to derive an expression for the radial part of the dipole transition matrix element. A.

539.132

8976. On Mohrenstein's calculation of the H_2 molecule. G. Freud. Letter in *Acta Phys. Hungarica*, **1**, 325–8 (*No.* 3, 1952) *In German.*

If $f(x) = \sum_0^\infty a_\nu x^\nu$ is a solution of the differential equation fundamental to the H_2 problem, what restrictions exist for the a_ν? This question is examined more strictly than in Mohrenstein's work.

J. Jacobs

539.132

8977. The intensities of harmonic bands of the HD molecule. T.-Y. Wu. *Canad. J. Phys.*, **30**, 291–301 (*July*, 1952).

The approximate intensity ratio 1 : 3 or 1 : 4 for the 4–0 and 3–0 vibrational bands of HD observed by Herzberg seems rather high on the basis of the usual anharmonicity considerations. To understand this, the problem is discussed qualitatively on the basis of classical mechanics. A quantum mechanical calculation of the intensities of various vibrational transitions is made by an extension of the perturbation theory treatment by Wick for the fundamental band. The relative intensities of the various vibrational bands are finally expressed as a function of the ratio $\xi = \alpha(0; 1)/\alpha(0; 0)$ of the matrix elements, with respect to the vibrational states 1 and 0, of a quantity closely resembling the polarizability of the molecule. For the 4–0 and 3–0 bands, the intensity ratio $I(4\text{–}0)/I(3\text{–}0)$ does not depend very much on the ratio ξ and has the value $\sim 0{\cdot}27$, in agreement with the approximate observed value. The case of the molecular ion HD^+ is also briefly discussed. A.

539.132

8978. The near ultraviolet bands of N_2^+ and the dissociation energies of the N_2^+ and N_2 molecules. A. E. Douglas. *Canad. J. Phys.*, **30**, 302–13 (*July*, 1952).

The u.v. emission bands of N_2^+ have been photographed using a 6 m grating, and a number of new bands of high vibrational quantum number have been found. It has been possible to show that the $B^2\Sigma_u^+$ state dissociates at a limit 70 358 cm^{-1} above the ground state. It is shown that these results give strong support to the value 9·75 eV for the dissociation energy of nitrogen, but the lower value of 7·37 eV cannot be eliminated with certainty. The peculiar manner in which the $B^2\Sigma$ state converges to its dissociation limit is interpreted as being caused by an interaction between the $B^2\Sigma_u^+$ and the $C^2\Sigma_u^+$ states. A.

539.132

8979. Evaluation of the zeta-sums for rotation-vibration interaction in axially symmetrical molecules. R. C. Lord and R. E. Merrifield. *J. Chem. Phys.*, **20**, 1348–50 (*Sept.*, 1952).

It is shown that the contribution of a set of equivalent nuclei to the zeta-sum for the fundamental vibrations of any symmetry species in a molecule possessing only one multiple axis of symmetry is zero unless the nuclei are situated on the axis. In the latter case the contribution of the set of equivalent nuclei to the zeta-sum in any species is one unit for every degree of freedom the set contributes to that species. With the help of these theorems a table is worked out from which the zeta-sums can be determined immediately for any axially symmetrical molecule of known structure. Use of the table is illustrated with several simple examples. A.

539.132

8980. Some molecular constants of $HC^{13}N$. R. E. Kagarise, H. D. Rix and D. H. Rank. *J. Chem. Phys.*, **20**, 1437–8 (*Sept.*, 1952).

The 003, 103 and 004 rotation-vibration bands of $HC^{13}N$ have been observed in the photographic infrared region of the spectrum. In addition, the Raman spectrum of the liquid was obtained with sufficient dispersion to measure the isotopic shift of ν_1. Values are given for B', B'', D' and D'' of the three infrared bands as well as for α_1 and α_3. The average value of $B'' = 1{\cdot}4400_6$ is in excellent agreement with $B'' = 1{\cdot}44008$ calculated from microwave data and the velocity of light as $c = 299\,776$ km/sec. A.

539.132

8981. The potential energy curve of mercury hydride. G. Glockler and H. Ven Horst. *J. Chem. Phys.*, **20**, 1448–51 (*Sept.*, 1952).

A potential energy curve for the mercury hydride molecule is constructed which takes into account the fact that the molecule can change from a structure bonded by exchange forces below about 2·65 Å, to a quasi-molecule held together by London dispersion forces at larger distances. The breaking off of certain bands can be understood on the basis of maxima in vibrational-rotational energy curves. A.

539.132

8982. Electronic states of ethylene molecule. T. Murai. *Progr. Theor. Phys.*, **7**, 345–52 (*April*, 1952).

Electronic states of ethylene molecules are discussed according to the LCAO method of molecular orbitals. The molecule is regarded as a system which consists of two $2p\pi$ electrons in a field of a skeleton. It is assumed that effective charges for $2p\pi$ orbitals are not the same as those for orbitals in the skeleton. Values of the effective charge are determined so as to minimize the energy of each electronic state. The result for excited electronic energy is compared with experiment, and their agreement is found though the observed values are very ambiguous. A relation between LCAO and valence bond methods is discussed. A.

539.132

8983. The low-energy satellite of the valence band spectra of some insulators. S. B. Bhattacharjee. Letter in *J. Sci. Industr. Res.*, **11B**, 199–200 (*May*, 1952).

These are explained by a partial absorption of the K_α radiation by the valence electrons. These electrons

jump to the nearest vacant band, and the incident photon loses energy equivalent to the energy difference of these band centres. Introduction of Zn, Ni and Cu into the BeO lattice show a weak broad band at 14·63, 14·80 and 14·53 eV resp. from the parent L_α band, agreeing with the energy difference of the filled and the vacant band of BeO ($\simeq$ 15 eV).

C. TURNER

539.132

8984. Notes on the identification of the ground state of the TiO molecule. J. G. PHILLIPS. Note in *Astrophys. J.*, **115**, 567–8 (*May*, 1952).

Observations of changes with temperature in the relative intensities of representative triplet and singlet bands under conditions of thermodynamic equilibrium show conclusively that the $X^3\Pi$ state is the lowest observed state of the TiO molecule, and may be regarded as the ground state. D. L. EDWARDS

539.132

8985. The correspondence between the resonance and molecular orbital theories. M. J. S. DEWAR AND H. C. LONGUET-HIGGINS. *Proc. Roy. Soc. A*, **214**, 482–93 (*Oct.* 9, 1952).

The resonance theory of organic chemistry is critically examined from a theoretical viewpoint. It is stressed that this theory is not rigorously founded on the quantum-mechanical valence bond method, but involves additional assumptions which cannot be defended. The practical success of the resonance theory must therefore be explained in some other way. It is here shown that a remarkable correspondence exists between the resonance theory and the molecular orbital method; and it is suggested that the resonance theory owes its success more to this correspondence than to the validity of its own premises. A.

539.133

8986. Anisotropic absorption of light and the orientation of electronic oscillators in the molecules of dyes. L. V. SMIRNOV. *Dokl. Akad. Nauk SSSR*, **82**, 237–40 (*No.* 2, 1952) *In Russian.*

The molecules were orientated by stretching a polyvinyl alcohol membrane dyed by mixing the solution of the dye with the solution of the polymer. Polarized absorption spectra of 35 dyes (azo, azine, triphenylmethane and polycyclic) were obtained, the correlation between the form of the spectrum and the structure of the dye molecule being determined by the number of bands in the range 1000–220 mu, the location of bands, and the magnitude and sign of dichroism. It was found that some bands were due to the presence of specific substituents in the benzene and naphthalene rings. The orientation of the electronic oscillator related to the principal band is determined by the longest chain of conjugated bonds. The orientation of electronic oscillators in the local π-electron systems depends on the nature and position of substituents. F. LACHMAN

539.133

8987. Some statistical mechanical models of elastic polyelectrolytes and proteins. T. L. HILL. *J. Chem. Phys.*, **20**, 1259–73 (*Aug.*, 1952).

Three statistical mechanical models are developed for use in connection with the problem of muscle action. In addition, the models should apply to certain other systems, for example, polyelectrolyte fibres or gels, fibrous proteins in general, and ion exchange resins. The first model is a statistical mechanical version of the "autone" model of Varga, Szent–Gyorgyi, Gergely and Laki, but the theory is extended to include the effect of an adsorbed substance (e.g. ATP) on the length of the elastic element. The second model is a charged rubber-like cylindrical fibre. The charges on the molecular chains of the network may be permanent or may result from the adsorption of ions from solution (e.g. hydrogen ions, or ATP). The approximate free energy of the system is computed by combining the Flory–Rehner swelling theory, the Fowler–Langmuir adsorption model, and an electrostatic free energy based on a "smeared" uniform charge density inside the fibre (electrolyte is also present), as suggested by the work of Hermans and Overbeeck (1948). The third model is an equilibrium statistical theory of the well-known $\alpha - \beta$ transformation in fibrous proteins (such as keratin and myosin) Adsorption of ions from solution and electrostatic effects can be included here as well as in the preceding model, but the discussion is concerned primarily with an analysis of the elasticity of a sheet of polypeptide chains with α- and β-units statistically scrambled taking into account as a nearest-neighbour problem in statistical mechanics (using the quasi-chemical method) lateral $\beta - \beta$ hydrogen bonds and vertical $\alpha - \alpha$ hydrogen bonds. A.

539.133

8988. The excluded volume of polymer chains. J. J. HERMANS, M. S. KLAMKIN AND R. ULLMAN. *J. Chem. Phys.*, **20**, 1360–8 (*Sept.*, 1952).

The "random flight" distribution function for the relative positions of two segments of a linear polymer chain is based on the assumption that the space occupied by a single polymer segment is relatively small and may be neglected. In this paper, the space requirements of a real polymer chain are taken into account. A generalized Fokker–Planck equation is formulated, and the distribution function, the average square distance and average inverse distance between two chain segments are calculated. A.

539.133 : 535.343–14

The microwave spectra, structure, dipole moment, and chlorine nuclear quadrupole coupling constants of methylene chloride. *See Abstr.* 8789

539.133 : 548.737

The crystal and molecular structure of α-glucose. *See Abstr.* 9201

ATOMIC STRUCTURE . NUCLEUS . ISOTOPES
539.15

539.152.1

8989. On the structure of heavy nuclei. O. MIYATAKE. *Progr. Theor. Phys.*, **7**, 285–302 (*March*, 1952).

For nuclei with $A > 110$ it is assumed that the nuclear matter is nearly incompressible and the constituent neutrons have a tendency to cluster into closed shells, which are of a spherical shape and

arranged concentrically in the spherical nucleus. Inner shells are bound more tightly than the outer ones. The proton density is determined only by the proper nuclear force and the Coulomb repulsion, and is given by the formula $\rho(r) = \text{const.}\,[1 + 1/6\,.\,(r/7\cdot 3r_0)^2]$. A shell mixed with the protons is called a core. A core is destroyed if at least one of its constituent neutrons or protons is knocked out. The part thus destroyed is assumed to make a liquid-like behaviour in the fissioning of heaviest nuclei, and the thermodynamical treatment is applied to this part only. Under these assumptions: (i) $r_0 = 1\cdot 32\times 10^{-13}$ cm when $A \gtrsim 200$, (ii) the shape of the fission yield curves of heaviest nuclei is explained, (iii) the released energy in the fission of U^{238} is about 195 MeV, (iv) the energy level spacing of heavy nuclei is greater than that obtained from the uniform liquid-drop model, and (v) the cross-section of the neutron inelastic scattering by heavy nuclei is smaller, and the velocity of the scattered neutron is larger than those so far obtained. The introduction of the core explains the irregularity of the intensity of the fluorescent γ-ray emitted from nuclei, and makes the specific heat of heavy nuclei smaller than that so far theoretically obtained. A.

539.152.1

8990. The binding energy of the α-particle. J. IRVING. Letter in *Phys. Rev.*, **87**, 519–20 (*Aug.* 1, 1952).

Feshbach and Schwinger's nuclear potential, consisting of central and tensor forces used with exponential-type wave functions, gives the binding energy analytically. It is 19–24 MeV with parameters which fit the triton binding energy, but only 7 MeV if, following Hu and Hsu [Abstr. 1618 (1951)], equal central and tensor ranges are taken. W. J. SWIATECKI

539.152.1

8991. Statistical theory of atomic nuclei. P. GOMBÁS. Letter in *Nature* [*Lond.*] **170**, 362–3 (*Aug.* 30, 1952).

For a pure exchange Yukawa potential, the nuclear energy is minimized for Gaussian shape of neutron and proton density functions. For suitable potential strength, the mean behaviour of nuclear binding energies is well described for the whole periodic table, two corrections made here to the statistical model being important for the light nuclei. See also Abstr. 6690 (1952). R. H. DALITZ

539.152.1

8992. The spherical shell nuclear model. H. A. WILSON. *Proc. Roy. Soc. A*, **214**, 446–51 (*Oct.* 9, 1952).

It is found that the spherical shell nuclear model has new energy levels due to the interaction of the vibrations and the rotation. Each vibration level has a series of equally spaced levels belonging to it. The levels of Al^{28} and Si^{28} are compared with the values predicted by the theory and good agreement is found. A.

539.152.1

8993. Studies in *jj*-coupling. II. Fractional parentage coefficients and the central force energy matrix for equivalent particles. A. R. EDMONDS AND B. H. FLOWERS. *Proc. Roy. Soc. A*, **214**, 515–30 (*Oct.* 9, 1952).

For Pt I, see Abstr. 4529 (1952). Jahn's method of fractional parentage coefficients is adapted to obtain fully antisymmetric wave functions for the configurations j^n of neutrons and protons, where $j = \frac{3}{2}, \frac{5}{2}, \frac{7}{2}$ and $n = 3$ and 4. Invariant theory is used to obtain linear combinations of Slater integrals which have special transformation properties with respect to the unitary and symplectic groups. In this way it is shown how the ordering of levels in *jj*-coupling with short-range central interactions is determined by the eigenvalues of Casimir's operator. A.

539.152.1

8994. The 7·4-MeV state of Li^7. M. PESHKIN AND A. J. F. SIEGERT. *Phys. Rev.*, **87**, 735–6 (*Sept.* 1, 1952).

Blair and Holland have reported preliminary measurements of the cross-section for the $Li^6(n, \alpha)$ reaction as a function of the neutron energy. Roberts *et al.* have measured the angular distribution of the tritons for a neutron energy of 270 keV. Assuming that the nonresonance part of the cross-section is due entirely to *s*-neutrons and that there is no accidental degeneracy of the resonance state, this state is shown (subject to possible revision) to have spin $\frac{3}{2}$. Experiments which might test the assumptions are discussed. A.

539.152.1

8995. Nuclei as compressible drops. I. The nucleus in its ground state. S. FLÜGGE AND K. WOESTE. *Z. Phys.*, **132**, 384–98 (*No.* 3, 1952) *In German.*

The drop model of nuclei is refined by assuming a compressibility which causes a tendency of the "proton fluid" and the "neutron fluid" to separate. This produces a centrifugal force increasing with the atomic number. For $Z > 36$ there is in the nucleus a zone under tension, and the tension becomes so strong at $Z \sim 91$ that the average hydrostatic pressure in the interior vanishes. Because of this force nuclear radii increase somewhat faster than as $A^{1/3}$. The corrections to the binding energies are not very important. L. PINCHERLE

539.152.1

8996. Nuclear spectroscopy with harmonic oscillator wave-functions. I. TALMI. *Helv. Phys. Acta*, **25**, 185–234 (*No.* 3, 1952).

After a survey of the shell model and of the application of the Slater method of atomic spectroscopy to nuclear problems, it is pointed out that many difficulties can be overcome by using as co-ordinates $r_1 + r_2$ and $r_1 - r_2$, and assuming that the potential is separable in these two co-ordinates. The only potential which satisfies this condition is the harmonic oscillator potential. Matrix elements of the interaction energy between nucleons of the outermost shell are then worked out using harmonic oscillator wave functions. The second part treats the determination of the ground state of the j^n configuration, in particular the dependence of the results on the form and range of the potential for the $(d_{5/2})^3$, $(f_{7/2})^3$, $(g_{9/2})^3$ configurations. The third part deals with the spin-orbit interaction. Finally the Li^7 nucleus is discussed in detail and it is shown that, taking into account tensor forces, it is possible to explain the coincidence of the four theoretically expected excited levels into the single one observed experimentally. L. PINCHERLE

539.152.1 : 539.165.2

8997. Introduction to the comparative study of the nuclear model of M. Mayer and the β-disintegrations of nuclei. M. Trocheris. *J. Phys. Radium*, **13**, 299–307 (*May*, 1952) *In French.*

The independent particle model of the nucleus is briefly described, and the Mayer model considered as a special case of it. Applying these considerations to nuclei with odd A, a method is deduced for determining the change of spin and parity in a β-transition.

J. HUGHES

539.152.2

8998. Non-additivity of nucleon magnetic moment in the deuteron. H. Miyazawa. *Progr. Theor. Phys.*, **7**, 207–16 (*Feb.*, 1952).

The modification of a nucleon's anomalous magnetic moment by the proximity of another nucleon was estimated, employing the pseudoscalar meson theory. Contribution of this effect to the deuteron magnetic moment turns out to be of the order of $\sim 0{\cdot}12|U|/\kappa$, where κ = the rest energy of pion and U = the potential energy of the deuteron ($\sim$14 MeV). The precise prediction of this value is impossible because of the lack of any satisfactory form of meson theory. The main conclusion reached is that the magnetic moment of the deuteron does not determine the fraction of D state mixture. Including the effect of relativistic correction (which induces the uncertainty of $\sim 1{\cdot}5\%$), the D state percentage of the deuteron would be from 2 to 8% or more. A.

539.153

8999. A note on energy levels of hydrogen atom with finite size nucleus. Pyarelal and P. L. Bhatnagar. *Proc. Nat. Inst. Sci. India*, **18**, 193–6 (*May–June*, 1952).

The solution of the Schroedinger equation for a H atom with a finite size impenetrable nucleus is worked out. A.

539.153

9000. The spatial correlation of electrons in atoms and molecules. II. J. E. Lennard-Jones. *Proc. Nat. Acad. Sci.* [*Wash.*] **38**, 496–502 (*June*, 1952).

For Pt I, see Abstr. 6702 (1952). The electrostatic interaction between electrons, whether of the same or opposite spin, is investigated as a function of six-dimensional space. In this space the function consists of terms of different symmetries which allows a simplification of the general problem. For He an in-out correlation as well as an angular one may be estimated from the wave function; for H_2 a correlation exists with respect to the plane of symmetry and in the azimuthal angle. J. JACOBS

539.153

9001. The binding energy of the Thomas–Fermi atom. J. M. C. Scott. *Phil. Mag.*, **43**, 859–67 (*Aug.*, 1952).

The Thomas–Fermi statistical model of the atom leads to the formula $20{\cdot}92\,Z^{7/3}$ eV for the total binding energy of an atom with atomic number Z, but this formula gives values which are too high by roughly 20%. The actual binding energies increase quite smoothly with increasing Z, which suggests the existence of a more appropriate formula. The reasons for the discrepancy are explained and a new theoretical formula derived. This is compared with spectroscopic and self-consistent field data and is found to agree within 1 or 2%. Some uncertainty remains about the relativistic correction for heavy atoms. A.

539.153

9002. On an extension of the statistical formulation of the exclusion principle of electron states in atoms. P. Gombás. *Acta Phys. Hungarica*, **1**, 285–94 (*No.* 3, 1952) *In German.*

An improvement in the statistical formulation of the exclusion principle due to the atomic core in terms of an effective potential is obtained by grouping the electrons according to the orbital quantum number. Atoms whose cores have an outermost d-shell can be treated. Simple energy-level calculations for Cu, Ag, Au, Zn, Cd, Hg are possible. W. J. SWIATECKI

539.153

9003. On a theoretical bas's of Slater's semi-empirical atomic eigenfunctions. P. Gombás and R. Gáspár. *Acta Phys. Hungarica*, **1**, 317–24 (*No.* 3, 1952) *In German.*

This is obtained using the effective potentials of the preceding abstract. Calculations of the electron density for Ne, Ar, Kr and Rb^+ compare well with those of Slater and the "consistent-field" approximation. W. J. SWIATECKI

539.153

9004. On a statistical atomic model in which the electrons are grouped according to the orbital quantum number. P. Gombás. *Acta Phys. Hungarica*, **1**, 295–300 (*No.* 3, 1952) *In German.*

In integrations in momentum space the Fermi sphere is subdivided into cylindrical shells. The equations governing the potential and the particle distribution are derived. The convergence difficulties encountered by Hellmann (1936) and Fényes (1948) do not appear. W. J. SWIATECKI

539.155.2 : 532.74

Istopic fractionation by ionic hydration. *See Abstr.* 8727

RADIOACTIVITY . α-, β- and γ-RAYS 539.16

539.16.08

9005. Production of helium by alpha particles from radium in solution. F. A. Paneth. *J. Chem. Phys.*, **48**, 163–7 (*March–April*, 1951) *In French.*

Kohman's method of measuring the curie is described, and some advantages are claimed for the helium production method. The apparatus used in preliminary experiments is described. A short discussion follows the paper. F. R. HOLT

539.16.08

9006. Radium determinations in deep-sea sediments. T. Bernert. *S.B. Öst. Akad. Wiss., IIa*, **160**, 99–111 (*No.* 1–5, 1951) *In German.*

Cores obtained by an expedition under H. Pettersson up to 18 meters below the sea bottom were examined, in the hope of showing that the ionium from U decay in sea water is deposited. The Ra in the sediment

would then give a method of dating it. Results of Urrey (1949) are also considered. The results are inconclusive. F. R. HOLT

539.16.08

9007. Utilization of holes drilled in rocks for the study of their penetrating radiation. A. HÉE AND R. LECOLAZET. *C.R. Acad. Sci.* [*Paris*] **235**, 201–3 (*July*, 1952) *In French.*

Two experiments are described which demonstrate the advantages of placing counters within the rock rather than near its surface. Considerable uncertainties due to geometry, emanation and cosmic rays are avoided. J. J. WILKINS

539.16.08 : 614.898

Civil defence radiation monitoring instruments. *See Abstr.* 9269

539.163.1

9008. Measurement of short beta-decay lifetimes. R. B. HOLT, R. N. THORN AND R. W. WANIEK. Letter in *Phys. Rev.*, **87**, 378–9 (*July* 15, 1952).

A carbon target in a cyclotron internal proton beam was observed directly with a scintillation counter immediately the cyclotron was turned off. β's from Li^9 produced by $C^{12}(p, {}^4p)Li^9$ were detected, giving a half-life of 170 ± 5 msec. F. R. HOLT

539.163.1

9009. Half-life of 139-min Dy^{165}. R. SHER, H. J. KOUTS AND K. W. DOWNES. Letter in *Phys. Rev.*, **87**, 523–4 (*Aug.* 1, 1952).

Dy_2O_3 powder embedded in lucite foils was pile-irradiated, then counted with a Geiger counter. The half-life was 139·17 ± 0·14 min. F. R. HOLT

539.163.1 : 539.152.1

9010. The half-lives of isomeric nuclei. B. STECH. *Z. Naturforsch.*, **7a**, 401–10 (*June*, 1952) *In German.*

Formulae for electric and magnetic multipole radiation are obtained using the single-particle nuclear model, and the necessary integrals calculated. For the single-particle model with strong spin-orbit coupling, the results are in good agreement with the exptl. energy-dependence of transition-probability (particularly for magnetic 2^4-pole transitions—$g_{9/2} \leftrightarrow p_{1/2}$; $h_{11/2} \leftrightarrow d_{3/2}$; $i_{13/2} \leftrightarrow f_{5/2}$) but the theoretical values are too high by a factor of ~30.

A. O. STANESBY

539.163.2

9011. Electron capture in Tl^{204}. A. C. G. MITCHELL AND R. S. CAIRD. Letter in *Phys. Rev.*, **87**, 388–9 (*July* 15, 1952).

Tl^{204} decays to Hg^{204} by *K*-electron capture, the 68 keV photons observed being the κ_α X-rays of Hg. F. R. HOLT

539.163.2

9012. Measurement of the branching ratio of *K*-capture/β^+-emission in ^{79}Kr. P. RADVANYI. *C.R. Acad. Sci.* [*Paris*] **235**, 289–91 (*July* 28, 1952) *In French.*

The ratio $K/\beta^+ = 14·1 \pm 4·0$ was found by counting the number of *K* Auger electrons and positrons originating in a definite volume of a cloud chamber into which some Kr^{79} gas had been introduced. Comparison of this result with theory gave indications of the decay scheme. J. HUGHES

539.163.2

9013. The specific alpha-activity of U^{234}. C. A. KIENBERGER. Letter in *Phys. Rev.*, **87**, 520 (*Aug.* 1, 1952).

The value obtained is $(1·347 \pm 0·004) \times 10^7$ disintegrations/minute/mg, and the half-life $(2·520 \pm 0·008) \times 10^5$ years. F. R. HOLT

539.163.2

9014. Decay scheme of $_{21}Sc^{48}$. D. KURATH. Letter in *Phys. Rev.*, **87**, 528 (*Aug.* 1, 1952).

It is suggested that the lack of observed β^+-decay from Ca^{48} to Sc^{48} results from the existence of a third γ in the decay of Sc^{48} to Ti^{48}; there would be insufficient energy for the β^--decay. See abstract following. F. R. HOLT

539.163.2

9015. Gamma-rays from Sc^{48}. B. HAMERMESH, V. HUMMEL, L. GOODMAN AND D. ENGELKEMEIR. Letter in *Phys. Rev.*, **87**, 528–9 (*Aug.* 1, 1952).

The γ predicted (preceding abstract) was observed and measured as 0·980 MeV, in cascade with the known 0·980 MeV line. It was found by intensity comparisons with the 1·33 MeV line and checked in a coincidence spectrometer. F. R. HOLT

539.163.2

9016. Lifetime of an excited state of Hf^{176}. F. K. MCGOWAN. Letter in *Phys. Rev.*, **87**, 542 (*Aug.* 1, 1952).

A half-life of $(1·35 \pm 0·10) \times 10^{-9}$ sec was measured, using a delayed coincidence scintillation spectrometer with Lu^{176} sources. The isomeric transition is *E*2. F. R. HOLT

539.163.2

9017. Natural radioactivity of lanthanum-138. G. I. MULHOLLAND AND T. P. KOHMAN. Letter in *Phys. Rev.*, **87**, 681–2 (*Aug.* 15, 1952).

Apparatus previously described [Abstr. 2932 (1952)] was used and results are analysed in some detail. An electron capture half-life of 7×10^{10} years and a negatron half-life of $1·2 \times 10^{12}$ years were found. F. R. HOLT

539.163.2

9018. The decay of Kr^{87}. S. THULIN. Letter in *Phys. Rev.*, **87**, 684 (*Aug.* 15, 1952).

This was collected on an Al foil and observed in a magnetic lens spectrometer. The β-energies found were 3·63 ± 0·07 MeV (75%) and 1·27 ± 0·1 MeV (25%). γ's of 405 ± 20 and 890 keV were also found, the latter being interpreted as the pair line of a γ of 1·89 ± 0·07 MeV. A further peak probably corresponds to a 2·3 MeV γ. F. R. HOLT

539.163.2

9019. Investigations on the odd-odd isotopes Ga^{64}, Ga^{66}, Ga^{68} and the odd-even isotope Ga^{67}. A. MUKERJI AND P. PREISWERK. *Helv. Phys. Acta*, **24**, 387–416 (*No.* 4, 1952).

Disintegrations of the odd-odd isotopes Ga^{64}, Ga^{66} and Ga^{68} have been investigated by spectrometer and coincidence measurements. The positron activity assigned in literature to Ga^{64} has to be attributed to some impurities. Disintegration schemes for Ga^{66} and Ga^{68} have been established. Spin assignments to ground states of Ga^{66} and Ga^{68} have been compared

to those predicted by Nordheim's rules regarding odd-odd nuclei. Some new γ-radiations observed during the course of disintegration of Ga^{67} are reported in the supplement and a disintegration scheme proposed. The findings are difficult to reconcile with the predictions from shell model in its simplest form. A.

539.164

9020. On the range-energy relation and ionization-energy relation for alpha-particles in air. K. KIMURA, R. ISHIWARI, K. YUASA, S. YAMASHITA, K. MIYAKE AND S. KIMURA. Note in *J. Phys. Soc. Japan*, **7**, 111–13 (*Jan.–Feb.*, 1952).

The effect on the range-energy curve of varying the ionization chamber voltage (50, 135 and 1140 V/mm) was investigated using α's from Po. With the lower voltages sufficient columnar recombination takes place to account for deviations from proportionality in the ionization-energy relation in air found by Holloway and Livingston (1938).

W. J. SWIATECKI

539.165

9021. Determination of maximum energy of β-emission of Ag^{108} and Ag^{110} by means of the absorption method. B. M. BOŽIĆ. *Bull. Soc. Chim. Belgrade* **15**, 161–5 (1950).

After a Ag plate has been bombarded by slow neutrons (paraffin as moderator) for 15 min, the absorption of the β-emission in Al foil of different thicknesses is measured by a Geiger counter. From the composite disintegration curve, log intensities for the β-radiation of Ag^{108} and Ag^{110} for equal time intervals are obtained and the thickness of the Al foil which absorbs half of the intensity of the β-emission determined, from which the max. energy is calculated. It is $2{\cdot}0 \pm 0{\cdot}4$ MeV for Ag^{108} and $3{\cdot}3 \pm 0{\cdot}4$ MeV for Ag^{110}. BRITISH ABSTRACTS

539.165

9022. Beta-spectrum of the third forbidden transition of Rb^{87}. Y. TOMOZAWA, M. UMEZAWA AND S. NAKAMURA. *Progr. Theor. Phys.*, **7**, 317–22 (*March*, 1952).

The Rb^{87} β-spectrum of the third forbidden transition is well explained by the combination of two matrix elements $Q_3(\beta[\sigma\times\mathbf{r}], \mathbf{r})$ and $Q_3(\beta\alpha, \mathbf{r})$. Complex γ-functions are calculated according to Martin. Screening correction is taken into account. A.

539.165.2

9023. Note on the forbidden transitions in beta-decay. Y. TOMOZAWA AND M. UMEZAWA. *Progr. Theor. Phys.*, **7**, 323–5 (*March*, 1952).

From the relative importance of certain matrix elements in β-decay, it is concluded that $v/c \gg R$, where v is the velocity of the nucleons within the nucleus of radius R (expressed in units of $\hbar/mc$). Certain β-transitions for which $\log ft = 5$–6 are possibly first forbidden transitions of $\Delta J = 1$, yes.

A. O. STANESBY

539.165.2

9024. Radiative correction to decay processes. III. Forbidden beta-transitions caused by radiation processes. S. HANAWA. *Progr. Theor. Phys.*, **7**, 391–8 (*April*, 1952).

For Pt II, see Abstr. 5095 (1951). Forbidden β-transitions caused by the radiative correction are investigated on the basis of the effective Hamiltonian previously derived, using the covariant formalism. The ultraviolet divergence inherent in the virtual photon processes has been removed with the aid of the regulator method. The results are compared with those described by other authors with the use of the non-covariant perturbation theory. A.

539.165.2 : 539.152.1

9025. β-transitions forbidden by nuclear structure. M. TROCHERIS. Letter in *J. Phys. Radium*, **13**, 370–1 (*June*, 1952) *In French.*

On the "independent particle" model, the matrix element of a β-transition will be zero where the initial and fixed states differ in the quantum nos. of more than one particle; it is suggested that this accounts for the high ft values of Y^{87}, Zr^{89}, Cd^{115} and perhaps C^{14}. A. O. STANESBY

539.166

9026. The investigation of soft radiations from ^{239}Pu and ^{233}U with a proportional counter. D. WEST, J. K. DAWSON AND C. J. MANDLEBERG. *Phil. Mag.*, **43**, 875–88 (*Aug.*, 1952).

Soft electromagnetic radiations from Pu^{239} and U^{233} have been investigated with a proportional counter filled with Kr and Xe. Pu^{239} emits the L X-radiation of U with an intensity of $(4 \pm 1)\times10^{-2}L$ X-rays per α-particle. The L X-radiation arises as a result of the internal conversion of γ-rays. Residual unconverted γ-rays with energies of $52{\cdot}0 \pm 0{\cdot}3$ keV and $38{\cdot}5 \pm 0{\cdot}4$ keV are emitted. The intensities of these γ-rays are 7×10^{-5} and 2×10^{-5} quanta per α-particle respectively. K X-rays are emitted with an intensity of about 2×10^{-5} quanta per α-particle. A γ-radiation of energy equal to $45{\cdot}0 \pm 0{\cdot}3$ keV is ascribed to Pu^{238} and Pu^{240}. U^{233} emits the L X-radiation of Th with an intensity of $(4 \pm 1)\times10^{-2}$ L-rays per α-particle. γ-radiations of energies $42{\cdot}8 \pm 0{\cdot}3$ keV and $56{\cdot}1 \pm 0{\cdot}4$ keV are present with intensities of 5×10^{-4} and 10^{-4} quanta per α-particle respectively. See also Abstr. 7240 (1951). A.

539.166.08

9027. Comparison of air and tissue doses for radium gamma rays. M. TER-POGOSSIAN, W. B. ITTNER, III AND S. M. ALY. *Nucleonics*, **10**, 50–2 (*June*, 1952).

γ-Ray dosage was measured in a small anthracene phosphor enclosed in a Lucite sphere. The radium source enclosed in 5 mm of Pt was suspended by a thread at a variable distance from the sphere. Measurements were made in air and with source and detector immersed inside water phantoms of various size from 10 cm to 60 cm cubes. It was found that the dosage measured in water was independent of the size of the phantom and was greater than that measured in air at the corresponding distances of separation. L. R. SHEPHERD

539.166.74

9028. Angular distribution of Compton-coincidences. J. GIERULA. *Acta Phys. Polon.*, **11**, 36–48 (*No.* 1, 1951).

The angular distribution of coincidences due to a

beam of γ-rays in a telescope consisting of two G.M.-counters was investigated. There exists a maximum of coincidence rate for an angle of 30°c between the axis of the telescope and the beam of the γ-rays. The theoretical interpretation of the curve for the angular distribution of coincidences is given. It follows from the measurements that the angular distribution of scattered γ-rays agrees for the energy 2·62 MeV very well with the formula of Klein and Nishina. The relatively high efficiency of a double telescope for isotropic γ-radiation was explained. A.

539.166.83

9029. Internal conversion: study of some excited states of heavy nuclei by their conversion radiation. J. TEILLAC. *Ann. Phys.* [*Paris*] **7**, 396–452 (*May–June*, 1952) *In French.*

A brief account of the theory of internal conversion is given. A low pressure cloud chamber was used to study electrons of energy less than 100 keV from $MsTh_1$, Ac, Pa and Io; for Pa three new electron lines were found from the conversion of 44 and 66 keV γ-rays, while the conversion radiation in Io was mainly from the 68 keV γ-ray. Impregnated nuclear emulsions were used to look for electron tracks from internal conversion in the α-emitters U_{II}, Pu^{239} and Io; the Pu^{239} electronic radiation is mainly from the de-excitation of a 50 keV level in U^{235}, while that from $U_{II} \sim 55$ keV from a fine structure level with 30% intensity. Finally the conversion coefficients measured are compared with theory, in order to obtain the nature of the radiation emitted. 82 references. J. HUGHES

539.166.83

9030. An absolute determination of the *X*-line from ThC″. G. LINDSTRÖM. Letter in *Phys. Rev.*, **87**, 678 (*Aug.* 15, 1952).

The value obtained was $H\rho = 9986{\cdot}7 \pm 1{\cdot}5$ gauss cm. J. J. WILKINS

539.166.835

9031. On the absorption in aluminium of electron pairs created in lead by gamma-rays of ThC″ A. Z. HRYNKIEWICZ. *Acta Phys. Polon.*, **11**, 75–80 (*No.* 1, 1951).

The absorption of pair electrons in Al was measured by the method of G.M. counters working in coincidences. The absorption curve obtained was compared with curves calculated from the theoretical energy distributions of pair electrons given by Bethe and Heitler (1934) and Jaeger and Hulme (1936). The experimental curve fits much better with the curve calculated on the base of the theory of Jaeger and Hulme. A.

539.166.835

9032. Further aspects of the trident process. J. E. HOOPER, D. T. KING AND A. H. MORRISH. *Phil. Mag.*, **43**, 853–8 (*Aug.*, 1952).

The division of energy between the secondary particles in the direct production of electron pairs by fast electrons is discussed, and experimental results are compared with the Bhabha theory. The angular separations of the tracks of the secondary particles are considered. An event attributed to pair production by a fast meson is described. A.

539.166.94 : 616–073.75

Multichannel collimators for γ-ray scanning. *See Abstr.* 9272

539.167.3

9033. Methods of producing radioiron. R. W. DUNN. *Nucleonics*, **10**, 8–13 (*July*, 1952).

Quantitative data on yields of Fe^{55} and Fe^{59} in the deuteron bombardment of Fe, Mn and Co and fast neutron bombardment of Co are given. Details of the preparation of substantially iron-free cobalt are given and the method of electroplating the Co on to Cu probe targets described. The yield of Fe^{59} in 20 MeV deuteron bombardment of Co is $\sim 0{\cdot}07$ μc/μa-hr and the specific activity obtained with the Co targets described, was 3–10 μc/μg. L. R. SHEPHERD

539.167.3 : 541 : 66

9034. Possibilities of application of radioactive isotopes in chemistry and engineering. H. GÖTTE. *Chem.-Ing.-Tech.*, **24**, 204–9 (*April*, 1952) *In German.*

Describes a number of examples of the application of isotopes, grouped in the following sections: (*a*) utilization of the penetration and absorption of radioactive radiation (e.g. measuring small thicknesses, snow layer depth, or liquid level in tanks; checking the wear of refractory materials in furnaces; the ball of the falling-sphere viscosimeter), (*b*) utilization of the ionizing power (continuous discharge of potentials in textile industry), (*c*) marking of physical mixtures (gas velocity in blast furnaces, leakage in tubular electric cables, distribution of dusted insecticides, wear of metal surfaces), (*d*) radioactive isotopes as analytical aid, (*e*) tracer methods, (*f*) dilution analysis, (*g*) activation analysis (and automatic selection of ore by activation with neutrons) and (*h*) photochemical uses. F. LACHMAN

539.167.3 : 66

Radioactive isotopes in technical development. *See Abstr.* 9273–5

NUCLEAR REACTIONS 539.17

539.17

9035. Statistical errors of coefficients of experimental angular distributions expanded into spherical harmonics. P. M. ENDT. Letter in *Physica*, **18**, 421–2 (*June–July*, 1952).

Formulae for these are derived in the case when observations subject to statistical errors are made at equal intervals of $\cos\theta$. W. J. SWIATECKI

539.17 : 621.384.6

9036. The construction of nuclear physics apparatus at the A.C.E.C. M. HOYAUX. *A.C.E.C. Charleroi, No.* 2, 31–48 (1952) *In French.*

A descriptive survey, with many photographs of apparatus, of equipment made by A.C.E.C. for nuclear physics research. Subjects mentioned include: ion sources, d.c. accelerator sets, electrostatic generators, cyclotrons, Wilson chambers, Geiger counters, electronics equipment and vacuum apparatus. J. D. CRAGGS (R)

539.17

9037. Contributions to the theory of directional correlation. K. ALDER. *Helv. Phys. Acta*, **25**, 235–58 (*No.* 3, 1952) *In German.*

General formulae for the correlation of arbitrary particles (including polarization and arbitrary mixing) are derived. The influence of external fields in destroying the correlation is treated in detail. Formulae relating to Racah and Clebsch–Gordon coefficients are listed on 7 pp. W. J. SWIATECKI

539.172

9038. High energy nuclear collisions and the Fermi model. H. MESSEL AND H. S. GREEN. Letter in *Phys. Rev.*, **87**, 378 (*July* 15, 1952).

The authors' previous considerations [Abstr. 8293 (1952)] are confirmed by Hazen *et al.* [Abstr. 5187 (1952)] who also find that Fermi's theory predicts too wide an angular spread for the nucleon components of cosmic radiation. Some unknown process is in operation at very high energies which results in an intense concentration of the scattering in forward and backward directions. W. J. SWIATECKI

539.172

9039. Theoretical results on high energy nuclear collisions in light and heavy elements. H. MESSEL, R. B. POTTS AND C. B. A. MCCUSKER. *Phil. Mag.*, **43**, 889–99 (*Aug.*, 1952).

Cascade theories appropriate to the various schemes of plural production of mesons suggested by Heitler and Janossy (and one by the authors) are developed. A set of master diffusion equations are set up which contain the various schemes as special cases. Their exact solution is given and detailed numerical results are presented for one of the schemes. These are presented in a form suitable for direct comparison with those obtained experimentally using photographic plate techniques. It is suggested, now that the detailed numerical results are available, that a recomparison be made between theory and experimental results previously obtained, in order to see whether the scheme considered does or does not agree with experimental observations. Results are presented in tabular form both for light and heavy elements and for mesons as well as protons. A.

539.172

9040. Statistical fluctuations in nuclear evaporation. K. J. LE COUTEUR. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 718–37 (*Sept.*, 1952).

Previous treatments of nuclear evaporation have dealt with average values, neglecting fluctuations. In the present paper the fluctuations are considered in detail. The distributions of the number of neutrons and of the total energy associated with evaporation stars of a given size and the size distribution of stars of given total energy, are evaluated explicitly. Knowledge of the fluctuations is useful for interpretation of data concerning small stars, such as those produced by π-meson capture or by artificially accelerated particles. The fluctuations are not very important in the large stars and do not modify any of the results of the author's previous mean value calculations [Abstr. 4354, 6050 (1950)]. The analysis of the mean evaporation process has also been put into a simplified form, from which numerical results can easily be obtained. The method has been used to compare experimental data with various theoretical energy-temperature relations; the Fermi gas law previously used by the author seems to be the most satisfactory connection between the high-energy star data and the observed level density at low energies. A.

539.172

9041. Some complex boundary valued problem and its application to Kapur–Peierls' dispersion formula. T. SATOH. *J. Phys. Soc. Japan*, **7**, 474–81 (*Sept.–Oct.*, 1952).

The method of finding the dispersion-formula for the partial cross-section, due to Kapur and Peierls [Abstr. 2395 (1938)] may be simplified by suitable variable-transformations. A.

539.172

9042. Disintegration of light nuclei by σ-meson capture. S. ENOMOTO, Y. FUJIMOTO, S. HORIE AND Y. TSUZUKI. *Progr. Theor. Phys.*, **7**, 353–8 (*April*, 1952).

σ-Stars in photographic plates are classified into those originating from heavy and light nuclei. The branching ratio of disintegration modes, the α-p ratio and the energy distribution of emitted particles are measured for light stars. The following characteristic features of light stars are ascertained; (1) the large prong number, (2) the large α-p ratio, (3) the low kinetic energy of emitted particles, and (4) the frequent emission of heavy fragments. The disintegration of C^{12} into two α-particles and a proton are studied in detail, and the possible emission of Be^{8} nuclei is discussed. It turns out to be the main disintegration mode, and that the rest energy of σ-meson is primarily shared among only a few nucleons, the residual part of the nucleus remaining in a state similar to the excited levels reached by low-energy reactions. A.

539.172

9043. Electron excitation of nuclei. J. A. THIE, C. J. MULLIN AND E. GUTH. *Phys. Rev.*, **87**, 962–5 (*Sept.* 15, 1952).

The cross-section for an electric 2^l-pole transition produced by the electromagnetic field of fast electrons is derived in the Born approximation. Electric dipole-quadrupole interference is also obtained. Deuteron electrodisintegration is further developed, the theory now extending to 150-MeV energy transfers. Characteristic features of electron excitation experiments are mentioned, in particular the possibilities of obtaining information about nuclei and of observing the scattered electrons. A.

539.172 : 537.591.8

Nuclear reactions due to cosmic rays. *See Abstr.* 8924, 8928

539.172.1

9044. Momentum transfer in nuclear excitation by high energy particles. S.-C. FUNG AND I. PERLMAN. *Phys. Rev.*, **87**, 623–7 (*Aug.* 15, 1952).

When accelerated protons, deuterons and α-particles of the order of 100 MeV energy strike thin Al foils (0·25–0·5 mil), sizeable percentages of the Na^{24} formed are ejected by the recoil process. In the higher energy range the percentage of Na^{24} ejected from the foil decreases with increase in energy of the

incident particle. This behaviour is first shown semi-quantitatively to be a consequence of constant nuclear excitation in contrast to compound nucleus formation. Calculations are made for the expected loss of Na^{24} assuming compound nucleus formation along with randomly distributed ejection of particles in the production of Na^{24}, and the agreement is found to be satisfactory for 70-MeV protons and 80 MeV α-particles but not for higher energies. Calculations are also made for the case of constant nuclear excitation with the incident particle of degraded energy leaving in the forward direction, and satisfactory agreement with the experimental values are found here over the entire energy range studied. A.

539.172.13

9045. Angular correlation in the reaction $B^{11}(p; \gamma_1, \gamma_2)C^{12}$. T. P. Hubbard, Jr, E. B. Nelson and J. A. Jacobs. Letter in *Phys. Rev.*, **87**, 378 (*July* 15, 1952).

Using thick targets and 170 keV protons the angular distribution of the 11·8 MeV γ-ray was measured alone and (in two different geometries) in coincidence with the 4·5 MeV γ-ray. The results are consistent with spin 2 for both the 16·3 MeV and 4·5 MeV C^{12} levels. J. J. Wilkins

539.172.13

9046. The angular distribution of long-range alpha-particles from the bombardment of boron-11 by protons. D. M. Thomson, A. V. Cohen, A. P. French and G. W. Hutchinson. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 745–52 (*Sept.*, 1952).

The angular distribution of α-particles of long range from the reaction $B^{11}(p, \alpha)Be^8$ has been studied over the range 130 to 280 keV proton energy. A strong anisotropy varying with energy is observed and can be explained in terms of an interference between states of opposite parity in C^{12}. The theoretical analysis gives the result that the well-known 16·11 MeV level in C^{12} formed by resonant capture of 162 keV protons in B^{11} has spin 2 and even parity. A.

539.172.13

9047. Angular distributions of particle groups from deuteron bombardment of neon. R. Middleton and C. T. Tai. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 752–7 (*Sept.*, 1952).

The angular distributions of 9 proton groups, the elastically scattered deuteron group and an inelastically scattered deuteron group from the 8 MeV deuteron bombardment of Ne have been investigated using the photographic plate technique. The absolute differential cross-sections for the production of the various groups have been calculated and the spins and parities of some of the states of the residual nucleus Ne^{21} determined. A.

539.172.13

9048. Cross sections of the $D(T, n)He^4$ reaction for 80- to 1200-keV tritons. H. V. Argo, R. F. Taschek, H. M. Agnew, A. Hemmendinger and W. T. Leland. *Phys. Rev.*, **87**, 612–18 (*Aug.* 15, 1952).

Gas targets of D with an Al entrance foil of 1·5 mg/cm² were bombarded by tritons. Straggling and scattering of the tritons by the foil have been carefully considered and found to introduce reasonably small corrections. Energy loss in the entrance foil was determined by assuming that the sharp resonance peak in the reaction occurs at 165-keV triton energy as measured by T. W. Bonner (1950), and then making use of the dE/dx curve of S. D. Warshaw [Abstr. 2509 (1950)]. Neutrons from the reaction were observed by means of a BF_3 long counter whose energy response has been investigated. Angular distributions of the neutrons were measured and found to be isotropic in the c.m. system below 600 keV. Near 1 MeV the distributions deviate from isotropy, more neutrons coming off at the back angles. The maximum cross-section is 4·93 barns at the resonance. The limit of error on cross-sections is ±10%. A one-level nuclear dispersion formula has been fitted to the experimental curve and the resonance is ascribed to a level in the He^5 compound nucleus, arising from an S-wave interaction of the T and D, with quantum numbers $J = \frac{3}{2}$, $l = 2$. A.

539.172.3

9049. Gamma-neutron reactions in O^{16} and N^{14}. R. J. Horsley, R. N. H. Haslam and H. E. Johns. *Canad. J. Phys.*, **30**, 159–64 (*May*, 1952).

The cross-sections for the reactions $O^{16}(\gamma, n)O^{15}$ and $N^{14}(\gamma, n)N^{13}$ have been determined by measurement of the induced positron activities. The oxygen cross-section curve has a slowly increasing initial portion after which it rises rapidly to a maximum peak cross-section of 11·4 millibarns at 24·0 MeV. The nitrogen cross-section curve has an initial peak at about 13 MeV. Above 17 MeV this curve increases sharply to a maximum value of 2·84 millibarns at 24 MeV. In order to explain the shape of the nitrogen curve, a relative total neutron yield curve has been determined from 12 to 20 MeV by detecting the emitted neutrons with a rhodium foil. This neutron yield curve has the same shape as the nitrogen saturated specific activity curve. The anomalous shapes of the nitrogen and oxygen cross-section curves are explained in terms of the variation of γ-ray absorption with energy. A.

539.172.3

9050. The measurement of photonuclear cross sections in isotopes leading to short-lived decay products. R. N. H. Haslam. R. G. Summers-Gill and E. H. Crosby. *Canad. J. Phys.*, **30**, 257–69 (*May*, 1952).

A dropping apparatus, including a new means of dosage rate monitoring, has been designed to allow the observation of short-lived activities produced by betatron irradiation of various parent materials. The photonuclear cross-section for the reaction $S^{32}(\gamma, n)S^{31}$ has been measured by this means. The cross-section has a peak value of 24·6 millibarns at 20·1 ± 0·5 MeV, a half width of 4·5 MeV and an integrated cross-section of 0·12 MeV-barns. The reaction threshold was found to be 15·0 ± 0·1 MeV. The experiment has also yielded a new half-life for S^{31} — 2·66 ± 0·03 sec. A.

539.172.3

9051. Photo-meson production from deuteron. S. Machida and T. Tamura. *Progr. Theor. Phys.*, **6**, 572–80 (*July–Aug.*, 1951).

Photo-meson production from deuterons is treated phenomenologically, using the "impulse" approximation. It is found that the distortion of the nuclear

wave function is essential and that its effect is taken into account adequately by "shape independent approximation." Production of negative mesons is diminished by the effects of Coulomb interaction between two protons in the final state. A.

539.172.3

9052. Multiple resonances in photodisintegration cross sections. F. K. GOWARD AND J. J. WILKINS. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 671–2 (*Aug.*, 1952).

Nuclear emulsion studies show resonances at about 22·6, 25·8 and 29·5 MeV in the $O^{16}(\gamma, 4\alpha)$ cross-section, and about 18·4, 21·8, 24·5 and 29·4 MeV in the $C^{12}(\gamma, 3\alpha)$ cross-section. Several further resonances are suspected. J. J. WILKINS

539.172.3 : 530.145

9053. Neutral-meson production by gamma-ray. S. MINAMI. *Progr. Theor. Phys.*, **7**, 69–92 (*Jan.*); *Erratum*, 267 (*Feb.*, 1952).

By means of the Lorentz-covariant perturbation and renormalization methods, the effective cross-section for the γ~π^0 process in pseudoscalar meson theory has been obtained with the matrix elements calculated up to the order ef^3. The most conspicuous result, which could not be reached in the lowest order calculation, is that the cross-section for neutral meson production turns out to be of the same order as that for charged meson, and that the angular distribution for that process is larger in the forward than in the backward direction. Further, a Pauli-type interaction with suitably chosen coupling constants has been introduced in order to estimate the effect of the matrix elements of orders higher than ef^3, and gained a result similar to the above, but with a smaller value for the coupling constant. A.

539.172.3 : 530.145

9054. Meson production by γ-rays from deuterium. Y. SAITÔ, Y. WATANABÉ AND Y. YAMAGUCHI. *Progr. Theor. Phys.*, **7**, 103–21 (*Jan.*, 1952).

Photo-$\pi^{\pm}$- and π^0-mesons from D, which are expected to give a definite clue to photo-mesons from neutrons and spin- and charge-dependences of photo-mesonic processes, are discussed phenomenologically, adopting the so-called impulse approximation. Energy spectra of mesons at 3 angles (0, 45 and 90 degrees) are given in figures for incident γ-rays with 200, 250, 300 and 350 MeV. The results will be useful for direct comparison with observed data. A.

539.172.4

9055. The effects of recoil in finely divided substances irradiated with neutrons. P. JORDAN. *J. Chim. Phys.*, **49**, 179–81 (*March–April*, 1951) *In French.*

In (n, α) and (n, p) reactions occurring in finely divided powders, wet with a suitable liquid, it was found that the recoil separated the product, and concentrated it in the liquid. J. HUGHES

539.172.4

9056. Nuclear contribution to the retention following radiative thermal neutron capture. A. G. MADDOCK AND J. GREEN. *J. Chim. Phys.*, **48**, 207 (*March–April*, 1951).

The retention arises from either the recoiling atoms reforming molecules, or else radiative capture without bond rupture. This second contribution may be measured by comparing the retention for two isotopes generated in one irradiation and estimated in one chemical separation. This was done with Cr^{51} and Cr^{55}. F. R. HOLT

539.172.4

9057. Effects of tensor forces on the elastic scattering of nucleons by deuterons. H. HORIE, T. TAMURA AND S. YOSHIDA. Letter in *Progr. Theor. Phys.*, **6**, 623–4 (*July–Aug.*, 1951).

The elastic *n-d* cross-section is calculated in Born approximations, using a Serber-type *n-p* potential of Yukawa form [Christian and Hart, Abstr. 4377 (1950)] and several *n-n* potentials each closely related to the Christian and Noyes *p-p* potential [Abstr. 8804 (1950)]. The expressions are evaluated numerically for 90 MeV neutrons, and the angular distributions and total cross-sections are compared with experiment. R. H. DALITZ

539.172.4

9058. Nuclear cross sections for fast neutrons and interaction between high energy nucleons. K. IDA. *Progr. Theor. Phys.*, **7**, 269–74 (*March*, 1952).

Recent observation of proton-proton scattering shows that the agreement with existing phenomenological theories based on static potential is rather poor, and considerations of velocity-dependent forces are required. It is shown, however, that the only familiar velocity-dependent force, the spin-orbit coupling introduced by Case and Pais, is not acceptable from the consideration of high-energy neutron-nucleus scattering. A.

539.172.4

9059. The demonstration of an (n, α) reaction in iron. J. P. LONGCHAMP. *J. Phys. Radium*, **13**, 333–8 (*June*, 1952) *In French.*

An emulsion partly covered with a 10μ foil of iron was irradiated with $\sim 10^{10}$ thermal neutrons per cm². The excess of traces found behind the foil leads to a cross-section of $1 - 2 \cdot 4 \times 10^{-28}$ cm² for $Fe^{56}(n, \alpha)Cr^{53}$. A semi-theoretical calculation is compared. W. J. SWIATECKI

539.172.4

9060. Inelastic scattering resulting in short-lived isomers. O. HITTMAIR. Letter in *Phys. Rev.*, **87**, 375–6 (*July* 15, 1952).

The angular distribution of γ's following inelastic scattering is written down in all generality and then simplified for a pure multipole transition and the statistical assumption for the compound nucleus. Numerical predictions are made for radiations from short-lived isomers produced by 200–400 keV neutrons on Cd^{111}, Er^{166}, Yb^{170}, Ta^{181} (2 levels), Os^{186}, Hg^{197} and Pb^{204}. W. J. SWIATECKI

539.172.4

9061. Deuteron production in the collision of high energy neutrons with nuclei. B. H. BRANSDEN. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 738–44 (*Sept.*, 1952).

The production of deuterons in high-energy collisions of neutrons with nuclei has been explained in terms of a direct "pick-up" process by Chew and Goldberger and by Heidmann, the reaction being of the form nucleus A + neutron → nucleus B + deuteron. Here it is shown that an alternative

reaction, in which the incident neutron interacts with a nucleon in the target nucleus, which in turn "picks up" a second nucleon to form a deuteron, is more important at incident energies greater than approximately 200 MeV (nucleus A + neutron → neutron + nucleus B + deuteron). The total cross-section for deuteron production is calculated numerically for energies of the incident neutron in the range 100–300 MeV and comparison is made with the results of the direct "pick-up" theory. A.

539.172.4

9062. Thermal neutron absorption cross section of deuterium. L. KAPLAN, G. R. RINGO AND K. E. WILZBACH. *Phys. Rev.*, **87**, 785–6 (*Sept.* 1, 1952).

The absorption cross-section of D for 2200 m/sec neutrons has been related to that of B by intercomparison with Li. A value of $0{\cdot}57 \pm 0{\cdot}01$ millibarn for D, based on a measured value of 755 barns for B, has been obtained. A.

539.172.4

9063. Thermal neutron capture cross section of A^{40} and observation of A^{42}. S. KATCOFF. *Phys. Rev.*, **87**, 886–8 (*Sept.* 1, 1952).

The thermal neutron absorption cross-section of A^{40} was determined by measuring in calibrated proportional counters the amount of 110-min A^{41} produced from samples of A irradiated in a neutron flux whose magnitude was measured by β-γ coincidence counting of Au monitors. The result was $0{\cdot}53 \pm 0{\cdot}03$ barn. A^{42} was produced from A^{40} by two successive neutron captures and it was detected through its 12·5 hr. K^{42} daughter. A lower limit of 3·5 yr was set on its half-life. From this result the thermal neutron absorption cross-section of A^{41} is calculated to be greater than 0·06 barn. It was also shown that the thermal neutron absorption cross-section of A^{38} is $0{\cdot}8 \pm 0{\cdot}2$ barn. A.

539.172.4

9064. Radiative capture of thermal neutrons by Cd^{113}. R. W. PRINGLE, H. W. TAYLOR AND K. I. ROULSTON. *Phys. Rev.*, **87**, 1016–17 (*Sept.* 15, 1952).

Study of the radiative capture of thermal neutrons by Cd^{113} with a scintillation spectrometer gave 9·20 MeV as the neutron binding energy of Cd^{114}, and nuclear levels at 0·57, 1·33, 2·63, 3·49, 4·03 and 4·43 MeV. The relationship between the resolution of the spectrometer and γ-ray energy is shown. A.

539.172.4

9065. Liberation of neutrons in uranium fission. R. KELLER, J. M. THARRATS, F. VERDAGUER AND C. SÁNCHEZ DEL RÍO. *An. Real. Soc. Esp. Fis. y. Quím.*, **47(A)**, 27–30 (*Jan.–Feb.*, 1952) *In Spanish.*

The number of neutrons emitted per fission of the U nucleus has been measured by a method which is a development of that employed by Bradt. The experimental arrangement consisted in a Cu sphere (21 cm dia.) filled with UO_2 placed in the middle of a graphite cube (101 cm side). The result is $2{\cdot}49 \pm 12$ neutrons per fission. A.

539.172.4

9066. The measurement of the ratio of effective fission cross-sections for thermal neutrons from Pu^{239} and natural uranium. R. COHEN, E. COTTON AND A. LÉVÊQUE. *C.R. Acad. Sci.* [*Paris*] **235**, 159–61 (*July* 16, 1952) *In French.*

See also Abstr. 7560 (1952). A further measurement on the ratio of the fission cross-sections of Pu^{239} and natural U, in a beam of thermal neutrons (most probable velocity 2700 m/sec, below Cd cut-off) gave a value of $207{\cdot}0 \pm 3{\cdot}0$, compared with an earlier value of $203{\cdot}3 \pm 4{\cdot}0$. The fission rates of the two substances were measured separately in a gridded chamber, the flux being monitored with a Cu activation detector. The quantities of Pu and U were estimated from α-counting rates. The result is not in agreement with the ratio of the cross-sections given in the recently declassified list of nuclear constants. The latter refers to thermal neutrons of 2200 m/s most probable velocity and it is suggested that the difference might be due to different energy dependence of the cross-sections. L. R. SHEPHERD

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

9067. Calculation of the π-meson mass based on an electrodynamical model of the particle. B. MAKIEJ. Letter in *Acta Phys. Polon.*, **11**, 87–9 (*No.* 1, 1951).

The analogy between the dispersion formula for electromagnetic waves in plasma, and of de Broglie waves of a free particle, suggests a classical model for a non-spinning charged particle behaving like an electron carrying an extended pulse of electromagnetic energy. The mass of this system is $2 \times 137m$.

W. J. SWIATECKI

539.18

9068. The difficulties in the theory of the meson and of nuclear forces. B. KWAL. *Ann. Inst. Poincaré*, **12**, 207–22 (*No.* 4, 1951) *In French.*

The equations of spin 1 meson are reviewed and the source of the r^{-3} singularity in the corresponding interaction is traced. It is suggested that in the usual formulation there is a spurious asymmetry in the treatment of field quantities and potentials. "Real" potentials can be introduced from which both are derivable and which are gauge invariant and satisfy D'Alembert–Poisson equations. To achieve this a 5-dimensional formulation is used. The "real" potentials must be used in the construction of interaction terms. W. J. SWIATECKI

539.18

9069. Heavy mesons. J. G. WILSON. *Nuovo Cim.*, **9** (*Suppl. No.* 1) 90–6 (1952).

Reviews critically the present position concerning unstable particles heavier than π-mesons. E. P. GEORGE

539.18

9070. Fundamental length and mesonic mass. B. N. GHOSH. Letter in *Sci. Cult.*, **18**, 48–9 (*July*, 1952).

Using the rules of Born's reciprocity theory but replacing e^2/mc^2 by $(15/32) \times$ (proton radius), numbers like $212m$, $281m$, $695m$, $1100m$ can be obtained.

W. J. SWIATECKI

539.18

9071. The nature of the neutral π-meson. E. A. POWER. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 670–1 (*Aug.*, 1952).

Selection rules, approximate angular distributions and the exponent in the excitation function are written down for *s*, *p* or *d* Yukawa or Kemmer mesons produced by *S*, *P* or *D* (*n*, *p*) collisions. The possibility of determining the relative sign of the coupling to neutrons and protons is discussed.

W. J. SWIATECKI

539.18

9072. Narrow angle pairs of particles from nuclear interactions. J. J. LORD, J. FAINBERG, D. M. HASKIN AND M. SCHEIN. Letter in *Phys. Rev.*, **87**, 538–9 (*Aug.* 1, 1952).

Two cases of narrow-angle pair production (probably electrons, total energies about 200 MeV) in nuclear plates in pion beams are considered. They might be caused by production of either a γ or a neutral pion through collision with a proton.

F. R. HOLT

539.185

9073. A method of determining the efficiency of Ra–Be neutron sources. M. DANYSZ AND Z. WILHELMI. *Acta Phys. Polon.*, **11**, 71–4 (*No.* 1, 1951).

A simple method of measuring the efficiency of Ra–Be neutron sources has been elaborated. The method is based upon neutron induced β-radioactivity and avoids measurements of weak secondary effects in the presence of strong direct radiation from the Ra–Be source. The accuracy of the method is comparable with that of other, more elaborate, methods now in use. A.

539.185

9074. Angular distribution of neutrons scattered by He^4. P. HUBER AND E. BALDINGER. *Helv. Phys. Acta*, **25**, 435–40 (*No.* 4, 1952).

Using a *d*-*d* source this was measured in the region 3–4·14 MeV and the results, combined with those of Adair [Abstr. 5340 (1952)] were subjected to a phase analysis, which gave $P_{3/2}$ as the lowest level of He^5, followed by $P_{1/2}$ at 1·76 MeV. W. J. SWIATECKI

539.185

9075. Construction and calibration of a fast neutron scintillation spectrometer. G. L. GUERNSEY, G. R. MOTT, B. K. NELSON AND A. ROBERTS. *Rev. Sci. Instrum.*, **23**, 476–82 (*Sept.*, 1952).

A quadrupole coincidence scintillation counter telescope has been constructed for neutron studies with the University of Rochester 130 in synchrocyclotron. A calibration of pulse height *v.* proton energy has been obtained for the fourth crystal of the telescope. The response of this crystal to monoenergetic protons has been found to be in fair agreement with calculations for the distribution of energy loss for protons, made using the method developed by K. R. Symon. The instrument covers the range from about 50 to 240 MeV in recoil proton energy. A.

539.185

9076. Fast neutron counting with hydrogenous liquid phosphors. G. R. KEEPIN AND R. H. LOVEBERG. *Rev. Sci. Instrum.*, **23**, 483–4 (*Sept.*, 1952).

A series of controlled experiments has been undertaken to study the dependence of neutron counting efficiency on the type of liquid phosphor and on the geometry and light collection efficiency of the liquid container. Five hydrogenous scintillating liquids have been compared in various container geometries. From differential lead absorption measurements using a calibrated polonium-beryllium neutron source, neutron counting efficiencies from 5·4 ± 2% to 17·9 ± 6% have been obtained. A.

539.185 : 537.122

9077. The evaluation of some neutron-electron scattering experiments. O. HALPERN AND C. P. HSU. Letter in *Phys. Rev.*, **87**, 519 (*Aug.* 1, 1952).

Equations obtained by Fermi and Marshall [Abstr. 1075 (1948)] are confirmed for an incident neutron Maxwellian velocity distribution. It is suggested that the equations would not hold for a more realistic distribution of slow neutron velocities.

F. R. HOLT

STRUCTURE OF SOLIDS 539.2

539.21

9078. The properties of the interstitial compounds of graphite. II. The structure and stability of graphite residue compounds. G. HENNIG. *J. Chem. Phys.*, **20**, 1438–42 (*Sept.*, 1952).

For Pt I, see Abstr. 7301 (1951). Controlled decomposition of lamellar compounds of graphite produces substances intermediate in composition between graphite and lamellar compounds. These intermediate compounds have been termed residue compounds. They are much more resistant to decomposition than the lamellar compounds. The X-ray pattern of residue compounds shows a very slight increase in the *c* spacing of the graphite lattice. The increase is entirely insufficient to account for the trapped reactant. Consequently, the bulk of the trapped reactant is believed to be situated at crystal imperfections. Quantitative studies of the composition of graphite bromide residue compounds have shown that their composition is strongly dependent on the type and subdivision of the graphite used and the temperature to which the compounds have been heated. A.

539.21

9079. The properties of the interstitial compounds of graphite. III. The electrical properties of the halogen compounds of graphite. G. HENNIG. *J. Chem. Phys.*, **20**, 1443–7 (*Sept.*, 1952).

The presence of lamellar or of residual Br in artificial graphite reduces the resistance, the absolute magnitude of its temperature coefficient near room temperature, and the magneto resistance. The Hall coefficient increases and eventually changes from negative to positive values. The changes resemble very closely those obtained in the oxidation of graphite in sulphuric acid. This similarity in properties suggests that the electron acceptors in these compounds are only weak scattering centres for conduction electrons. Since the electrical properties of graphite bisulphate and of graphite bromide are very similar, it may be assumed that both compounds are of a similar type. Since the bisulphate compound

ionic in nature, the Br in graphite bromide is also obably ionized. On this assumption the graphite omides have the formulae $C_nBr.3Br_2$ for the mellar and $C_nBr.2{\cdot}25Br_2$ for the residue compounds. l reacts with graphite at low temperatures only. he properties of the compounds of Cl and graphite semble in all respects those of the compounds of r and graphite. Attempts to react I and graphite ave failed. ICl, however, reacts rapidly with raphite. A.

539.217 : 541.124

080. Simultaneous diffusion and reversible chemical eaction. J. CRANK. *Phil. Mag.*, **43**, 811–26 (*Aug.*, 952).

The problem considered is one of diffusion in hich some of the diffusing substance is immobilized y chemical reaction as diffusion proceeds. The eaction is considered to be first order and reversible, he forward reaction proceeding at a rate proportional o the concentration of solute free to diffuse and the ackward reaction at a rate proportional to the oncentration of immobilized solute. Mathematical olutions are derived for the diffusion of a limited mount of solute into a plane sheet, a cylinder and sphere respectively. The solutions comprise two nfinite series and the physical significance of the arious terms is discussed briefly. An important eneral conclusion is that if the diffusion is more than thousand times faster than the reaction, expressed n terms of the respective half-times of the two rocesses, the behaviour of the joint diffusion-reaction rocess is almost the same as if diffusion were nfinitely rapid. If on the other hand the half-times or diffusion and reaction are comparable the be- aviour approximates to that for an infinitely rapid eaction. It is shown that the mathematical solutions lerived for absorption also describe the course of lesorption under comparable conditions. Solutions or an irreversible reaction are deduced as special ases of those for a reversible reaction. A.

539.217

081. Dimensional changes normal to the direction of diffusion. R. W. BALLUFFI AND B. H. ALEXANDER. *. Appl. Phys.*, **23**, 953–6 (*Sept.*, 1952).

Ag from the vapour phase was diffused into thin Au wires and foils at 940°C. Measurements were made of the resulting dimensional changes which occurred normal and parallel to the direction of diffusion. The linear percentage expansion normal to the diffu- sion direction was always found to be only slightly less than the corresponding expansion parallel to the diffusion stream. The results are best explained by the creation of new lattice sites at dislocations and support both the vacancy and interstitial mechanisms of diffusion in substitutional solutions. A.

539.217

9082. Self-diffusion in pure polycrystalline silver. L. SLIFKIN, D. LAZARUS AND T. TOMIZUKA. *J. Appl. Phys.*, **23**, 1032–4 (*Sept.*, 1952).

Self-diffusion in pure polycrystalline Ag has been measured using Ag^{110} as a tracer. The results of the high temperature experiments, where volume diffusion is predominant, are in excellent agreement with those of other investigators. A least-squares calculation using all available data on volume diffusion of Ag gives as a value for the diffusion coefficient $D = 0{\cdot}724e^{-45{,}500/RT}$. The occurrence at low temperatures of grain boundary diffusion, in which the activity decreases exponentially with the first power of the penetration depth, as reported by Hoffman and Turnbull [Abstr. 5815 (1951)], is confirmed. A.

539.217

9083. Audodiffusion on the surface of copper. E. MENZEL. *Z. Phys.*, **132**, 508–28 (*No.* 4, 1952) *In German.*

Presents the results of experiments in which the surface transformation of an etched Cu monocrystal has been observed as a function of temperature, the time period required for a definite change being taken as a measure of the surface migration of Cu atoms on Cu lattice. It has been found that in air of 10^{-3} mm Hg the surface migration obeys a Boltzmann law in the interval of 1050–700°c, thus enabling the activation energy to be evaluated. When in a H atmosphere, the Cu monocrystals have shown a completely different behaviour, pointing to the possibility of a chemical reaction with the adsorbed or dissolved O. The theoretical equilibrium form of a Cu crystal, i.e. a smooth spherical surface, has been observed for the temperature range immediately below the melting point. F. LACHMAN

539.234 : 539.16.08 : 531.717.1

A tracer method for the thickness measurement of thin Bi films. *See Abstr.* 8698

539.26

9084. X-ray study of the structure of silver amalgams. S. R. SWAMY AND T. G. SHAMANNA. Letter in *Curr. Sci.*, **21**, 7–8 (*Jan.*, 1952).

Contrary to the results of Preston (1931) and others, no hexagonal β-phase could be detected in Hg–Ag alloys prepared by six different methods. The γ-phase (complex body-centred cubic, $a = 10{\cdot}02 \pm 2$ at ~30 wt% Ag) appeared at 16% Ag, and the two-phase $\alpha(Ag) + \gamma$ region extended from ~30% at least to 61% Ag. The lattice parameter of γ appears to increase with increasing Ag content in the single-phase region, but the measurements are not very accurate. A single crystal of γ showed $a = 10{\cdot}06$.

A. J. C. WILSON

539.26 : 539.216

9085. Occurrence of small-angle X-ray diffraction maxima in some artificial cellulose fibres. D. HEIKENS, P. H. HERMANS AND A. WEIDINGER. Letter in *Nature* [*Lond.*] **170**, 369–70 (*Aug.* 30, 1952).

Two types of fibre show, in the wet state only, diffraction maxima indicating lateral periodicities of 77Å and 84Å respectively. A. R. STOKES

539.27

9086. Markings found in the oxide replicas for electron microscopy. S. YAMAGUCHI. *J. Appl. Phys.*, **23**, 935–6 (*Sept.*, 1952).

There are two types of crystal edges in the electron micrographs of oxide replicas of metals. The first type is characterized by the edges being more transparent than the facets in reprinted crystals. In the second type of reprinted crystal there were found the opaque edges of crystal. These characteristics of crystal edges were explained by the orientation of crystallites composing the replica films. It is proposed

in the present study that the width of transparent edge of reprinted crystal might serve as a rough measure of microscopic magnification. A.

539.27

9087. On the metallic shadow-casting using a nozzle system. T. HIBI. *J. Appl. Phys.*, **23**, 957–63 (*Sept.*, 1952).

A new device for metallic shadow-casting by using the nozzle system is proposed, and an outline of the apparatus is given. The present device has a shutter, a nozzle and a cover plate between specimen and filament in addition to the usual apparatus. The dimensions of the nozzle were chosen from the maximum of 3-mm dia., 1·5-mm dia. and 22 mm to the minimum 1·5-mm dia., 0·7-mm dia. and 38 mm as dia. at the entrance, dia. at the exit and the length, respectively. It was found that this method was not only conspicuously effective in obtaining much more accurate shadows than that obtained by the usual method with the same shadowing material, but also brought into possible use metals, as shadowing materials, which could not be used for such a purpose by the usual method. Shadowing qualities of many kinds of evaporated metals are compared and a new rule for the order of aggregation of deposited metallic thin films is also proposed. A.

539.27

9088. The effect of accelerating voltage and specimen morphology on electron diffraction patterns. S. G. ELLIS. *J. Appl. Phys.*, **20**, 1024–8 (*Sept.*, 1952).

Using empirical relations established in the study of electron diffraction patterns of uniform thin films of Al, the contrast between the most intense ring and the background is calculated for other morphologies as a function of the accelerating voltage on the camera. In all cases the contrast increases with voltage. The gain is marked if the specimen is nowhere very thick. For specimens that have very thick regions the contrast increases approximately as the square root of the voltage in the range 50 to 150 kV. The situation in reflection-diffraction in general lies between these extremes. Increasing the voltage has a more limited effect on increasing the range of specimen thicknesses that can be examined than had been previously supposed. A.

539.27

9089. An electron diffraction study of some glasses. G. O. MCCLURG. *J. Chem. Phys.*, **20**, 1398–1400 (*Sept.*, 1952).

The interatomic spacings as obtained from the radial distribution method of analysis of electron diffraction patterns are given for vitreous silica, Vycor and Pyrex glasses. The results are in general agreement with the X-ray diffraction results published by others. A.

539.27 : 621.316.89

9090. Electron microscopic study of sintering in thermistor flakes. *Bell Lab. Rec.*, **30**, 285–7 (*July*, 1952).

Thermistor flakes, $\sim 4 \times 10^{-4}$ in thick, have been developed to provide large surface area and quick response to temp. change. The microscopic study was carried out to determine the optimum sintering temperature for achieving the most favourable noise characteristics. The test flakes were formed on a flat surface as a film which was then stripped off and cut into squares prior to sintering. The surface of the sintered flakes could not be viewed directly in the microscope and accordingly Si replicas were prepared by a process which is described. A series of micro-photographs show the increasingly crystal-like formation as the final firing temperature was raised from 720° to 1230°C, the temp. rate-of-change being maintained at 55°C/min. Prolonged heating at a final temperature of 1030°C resulted in an extremely compact stucture with superior electrical properties.

H. G. M. SPRATT (R)

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.32 : 537.226.22

On the theory of the dielectric, piezoelectric, and elastic properties of $NH_4H_2PO_4$. *See Abstr.* 8856

539.371

9091. Damping of string vibration due to the internal friction. T. NISHIHARA AND H. MIKI. *Tech. Rep. Engng Res. Inst. Kyoto Univ.*, **2**, 61–74 (*No.* 4, 1952) (*Rep. No.* 9).

Assuming a stress-strain relationship, the dependence of the log decrement on amplitude, frequency and tension of a wire is derived. Using the method of Abstr. 1239 (1952) the theory is compared with experimental results on piano wire. The effect of drawing and heat treatment are also investigated.

J. E. CAFFYN

539.373 : 548

9092. The mathematical theory of stationary dislocations. F. R. N. NABARRO. *Adv. Phys.*, **1**, 269–394 (*July*, 1952).

An extensive review under the following main headings: Pt I, introduction. Pt II, dislocations in an elastic continuum: (1) The development of dislocation theory (historical), (2) elementary properties of dislocations (associated stress fields; dislocations cannot end inside the medium). (3) The formal elastic theory of dislocations (Weingarten theorem on the possible types of dislocation; the six simple and other more general types of dislocation; Burgers theory of line dislocations; the energies of elastic dislocations). (4) The motion of dislocations (possible motions; Frank Read sources; the forces on a dislocation due to a uniform applied shear stress and to a varying internal stress field; forces between dislocations and between dislocations and solute atoms). (5) Arrays of dislocations (a row in the same glide plane; grain boundaries as walls of dislocations; lattices of dislocations). (6) The interaction of dislocations with free surfaces (elastic interaction; the influence of surface energy). (7) The line energy of dislocations (the case of a circular dislocation; various theories of creep involving an activation energy for the movement of dislocations; the average stress on a nearly straight dislocation). Pt III, the effect of the crystal structure: (1) Elastic dislocations and crystal dislocations (considerations arising from the atomic structure of crystals; approximations employed in treating crystal dislocations). (2) The Peierls approximation (for a single dislocation, for a pair of and for an array of

slocations; deviations from the sinusoidal law of rce assumed by Peierls; barrier problems). (3) The proximation of Frenkel and Kontorova. (4) Interion of an edge dislocation with the lattice potential ne change in energy of a dislocation as it moves rough the lattice; energy change due to the shape of dislocation departing from that of a straight line).) Dislocations in special crystal structures (dislocaon reactions and dislocation nodes; partial dislocaons; the glide systems of various crystal structures; inning and phase transformations). 170 references.

A. D. LE CLAIRE

539.374

93. Plastic deformation in beams. Y. V. G. CHARYA AND G. J. RAM. Letter in *Curr. Sci.*, **21**, 6–7 (*May*, 1952).

In a structural steel with distinct upper and lower eld points, a thin transition layer between elastic d plastic material can be regarded as a stress disntinuity similar to a hydrodynamic shock wave. ne effect of a double yield point on bending moments rectangular beams is discussed quantitatively.

J. G. OLDROYD

539.374 : 539.389.3

)94. The [plastic] flow curve and the elastic afterfect. M. I. ROZOVSKIĬ. *Zh. Tekh. Fiz.*, **22**, 880–2 *No.* 5, 1952) *In Russian.*

Starting with the Volterra integral relation for stress 931), it is shown that the curvature of the plastic ow region of the deformation-load curve obtained a tensile test depends only on the coefficients of laxation and after-effect for the material. It is ssumed that, when load is increased suddenly in qual steps and at equal time intervals, the stressrain relation is linear when the time intervals are fficiently long for the deformation to cease, and on-linear when the loads are applied whilst the eformation still goes on, as shown by Ivanov's xperiments (1948). A. GELBTUCH

539.389.3

095. On the thermodynamic theory of the elastic fter-effect. N. S. FASTOV. *Zh. Eksper. Teor. Fiz.*, 2, 487–92 (*No.* 4, 1952) *In Russian.*

Integro-differential equations of motion are derived nd solved, showing that at any given moment the tresses in a uniform isotropic body depend on the eformation and temperature at that instant, and on ne entire deformation history, but not on the temerature history; whilst the strains depend on the nstantaneous stresses and temperature and on the istory of both. The theory is applied to the study of he propagation of a longitudinal elastic wave in an nfinite medium, taking into account relaxation henomena. A. GELBTUCH

539.42

096. Tensile deformation of single crystals with a otatable holder. J. DIEHL AND A. KOCHENDÖRFER. *Z. angew. Phys.*, **4**, 241–7 (*No.* 7, 1952) *In German.*

A tensile apparatus is described which seeks to overcome the effects on the displacement of the slip planes close to the holder in the usual type of rigid upport. Experiments with large single Al crystals, n which one half was subjected to deformation using rigid support and the other half was in a freely novable holder showed that the method of support had a negligible effect on the plastic behaviour of a sufficiently long single crystal. H. J. H. STARKS

539.42 : 539.23

9097. Mechanical properties of thin films of silver. J. W. BEAMS, W. E. WALKER AND H. S. MORTON, JR. Letter in *Phys. Rev.*, **87**, 524 (*Aug.* 1, 1952).

The maximum tensile strength of Ag films was found to be constant down to thicknesses $\sim 2\times10^{-5}$ in and to increase markedly for thickness less than this value. For thicknesses greater than 2×10^{-5} in the tensile strength was a little more than the average value for annealed Ag wire (18 200 lb/in²); for films of thickness 2×10^{-5} in the minimum tensile strength measured was 104 000 lb/in² and increased as the thickness was decreased. A centrifugal method of applying uniform stress to the films was used. See Abstr. 757 (1947). H. P. MYERS

539.501

9098. Relaxation of tension in stretched dough. I. HLYNKA AND J. A. ANDERSON. *Canad. J. Techn.*, **30**, 198–210 (*July–Aug.*, 1952).

In essence, a motor-driven carriage stretches a ball of dough, impaled on a split-pin holder, to a preset distance, and holds the sample at constant length during the relaxation process. One of the dough stretching pins is connected through a steel spring to a strain gauge; a small displacement of the pin moves an iron slug in the field of a differential transformer, the voltage output of which is coupled to a kymograph by a suitable electronic system. The relaxation of dough under external tension is characterized by a linear relationship between tension and the logarithm of time and may be described by a single parameter, namely the slope of this function. Mathematically, the slope is the product of two variables, the rate of change in tension, and time, i.e. $-K = t(dS/dt)$. Relaxation of the type studied in this investigation has been reported in the literature to only a limited extent and a satisfactory theoretical basis still remains to be developed. A.

539.501

9099. Some cases of the axially symmetrical flow of perfectly plastic materials. N. INOUE. *J. Phys. Soc. Japan*, **7**, 512–18 (*Sept.–Oct.*, 1952).

Deals theoretically with one of the three-dimensional isostatical problems in the theory of plasticity. Fundamental equations for plastic states of stress in a solid of revolution are established under the assumptions that the circumferential principal stress is equal to one of the other two lying in the meridian section and that materials obey the theory of constant elastic strain energy of distortion. The author discusses the method of solving these equations for the case when the equations for slip-lines are known and two plastic states of stress having slip-lines of logarithmic spirals and straight lines are considered in details as practical examples of applying his method of solution. A.

539.501

9100. A new method of solution of the two-dimensional isostatical problem in the mathematical theory of plasticity. N. INOUE. *J. Phys. Soc. Japan*, **7**, 518–23 (*Sept.–Oct.*, 1952).

The author discusses an analogy between the statically determinate state of stress in the perfectly plastic material and the steady irrotational flow of a

hypothetical non-viscous fluid introduced by him, the pressure in which is proportional to the logarithm of its density and which has the same local Mach number $\sqrt{2}$ throughout the whole field of flow. The hodograph method for this fluid flow is developed in detail, and an application of the W.K.B. method is also considered. Several exact solutions of the fundamental differential equations illustrate the present new method. A.

539.62

9101. Metal transfer and wear. I.-M. FENG. *J. Appl. Phys.*, **23**, 1011–19 (*Sept.*, 1952).

A new theory. Metal transfer and wear take place at points of actual contact. The interfaces of the high spots that actually make contact are roughened as the result of plastic deformation when they carry normal load. The mechanical interlocking effect of these roughened interfaces is the primary cause of metal transfer and wear. Due to the mechanical interlocking effect of the roughened interface, and the strain-hardening that accompanies plastic deformation, the application of a tangential force will break one of the pair of the contacting high spots a certain distance away from the interface rather than at the original interface. A secondary cause of metal transfer is the adhesion or the diffusion process which takes place during the temperature flash that occurs during breakage. If the adhesive force is very weak and the diffusion process is not rapid enough to cause the sheared-off peak of the high spot to become a blob of transferred metal, the small piece of metal sheared from the high spot can leave as a loose wear particle. This proposed theory explains the welding of the sheared-off peak to its opponent high spot as the consequence of friction, whereas, in the "welding" theory of friction, welding is considered as the cause of friction. Most metallic surfaces in ordinary atmosphere are always covered by a surface film. The effect of surface contamination on metal transfer, wear and the shear component of friction is discussed. Difficulties encountered in applying the "welding" theory to explain the friction of and metal transfer between contaminated surfaces where metallic adhesion is absent, are obvious. Experimental support of this new theory is given here. It includes as direct evidence (1) the roughening of the interface as the result of the plastic deformation, (2) the perfect matching at the roughened interface, which gives a strong mechanical interlocking effect and (3) a definite region of severely strain-hardened metal near the interface. A.

539.62

9102. The load dependence of rubber friction. A. SCHALLAMACH. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 657–61 (*Sept.*, 1952).

It is shown experimentally that the load dependence of rubber friction can be explained as being due to the load dependence of the true area of contact between rubber and track if the surface asperities of the rubber are assumed to be hemispherical. A.

539.62

9103. The frictional properties of plastics. K. V. SHOOTER AND D. TABOR. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 661–71 (*Sept.*, 1952).

The frictional properties of a group of linear polymers have been investigated at loads ranging from a few milligrams to several kilograms at slow speeds of sliding. At light loads the coefficient of friction tends to increase but at loads above 100 g the coefficient of friction is generally constant and is almost independent of the size and shape of the surfaces. From the results obtained at loads above 100 g a tentative theory to explain the origin and magnitude of the friction has been developed. The theory is similar to that of Bowden and Tabor for the friction of metals. When a plastic slides on a harder metal strong adhesion occurs between the surfaces and shearing takes place within the bulk of the plastic rather than at the interface. The frictional force is essentially equal to the product of the area of contact and the bulk shear strength of the plastic. The experiments also show that the area of contact is proportional to the applied load so that the plastic behaves as if it possesses an effective yield pressure which is constant. The coefficient of friction is thus primarily determined by the bulk properties of the plastic and is equal to the ratio of the shear strength to the effective yield pressure of the plastic. When a plastic slides on a softer metal shearing occurs within the metal and the friction is primarily determined by the bulk properties of the metal itself rather than those of the plastic. Examination of the surface damage produced during sliding shows marked transfer of the softer to the harder material. The frictional behaviour of polytetrafluoroethylene differs from that of the other plastics in that the adhesion during sliding is small and shearing apparently takes place preferentially at the interface. However, when this plastic slides on a sufficiently soft metal marked adhesion and transfer of the metal to the plastic occurs. A.

539.62

9104. The transfer of metal to plastics during sliding. E. RABINOWICZ AND K. V. SHOOTER. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 671–3 (*Sept.*, 1952).

Investigations have been carried out on the amount of metal transferred when a radioactive metal is slid over the surface of a plastic. It is found that in every case metal fragments are transferred to the plastic in amounts that are of the same order of magnitude for the various metals and plastics examined. The close similarity of the results with those obtained with sliding metals suggests that, by a process analogous to the welding that occurs between metal surfaces, strong local adhesion occurs when metal and plastic are pressed and slid together. A.

539.89

9105. High pressure investigation. I. Densities and melting point curves. E. KUSS. *Z. angew. Phys.*, 4, 201–3 (*No.* 6, 1952) *In German.*

An experimental determination of the densities and melting points of nitrotoluene and nitrobenzene at high pressures. T. C. TOY

539.89

9106. High pressure investigation. II. The viscosity of compressed gases. E. KUSS. *Z. angew. Phys.*, 4, 203–7 (*No.* 6, 1952) *In German.*

The viscosities of methane and hydrogen were measured at pressures up to 600 atmospheres. T. C. TOY

PHYSICAL CHEMISTRY 541

541 : 66 : 539.167.3

Applications of radioactive isotopes in chemistry and engineering. *See Abstr.* 9034

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.11 : 541.57

9107. Heats of formation of mercury dimethyl, diethyl and diphenyl and some associated bond dissociation energies. A. S. CARSON, E. M. CARSON AND G. WILMSHURST. Letter in *Nature* [*Lond.*] **170,** 320–1 (*Aug.* 23, 1952).

New determinations of heats of combustion give the following heats of formation: $Q_f[Hg(CH_3)_2, l] = -14{\cdot}3 \pm 0{\cdot}1$; $Q_f[Hg(C_2H_5)_2, l] = -6{\cdot}5 \pm 0{\cdot}2$, and $Q_f[Hg(C_6H_5)_2, c] = -71{\cdot}6 \pm 0{\cdot}3$ kcal/mole, these values differing widely from Berthelot's data and being much closer to values derived by Skinner and co-workers. The calculated heat of formation of C_6H_5 radical is *c.* −69, and the C–H dissociation energy in C_6H_6 is *c.* 100 kcal/mole. F. LACHMAN

541.123.5

9108. Equilibrium in the exchange of hydrogen between phosphine and water. R. E. WESTON, JR, AND J. BIGELEISEN. *J. Chem. Phys.*, **20,** 1400–2 (*Sept.*, 1952).

The exchange equilibrium $PH_2D(g) + H_2O(l) = PH_3(g) + HDO(l)$ has been measured at 25°C by the use of dilute sulphuric acid and buffer solutions as a catalyst. From this measurement and the ratio of the vapour pressures of H_2O and HDO the equilibrium constant for the exchange $PH_2D(g) + H_2O(g) = PH_3(g) + HDO(g)$ is calculated to be 1·52 at 25°C. The latter experimental value is combined with a theoretical computation of the temperature independent factor of the equilibrium constant to evaluate the difference in the zero point energies of PH_3 and PH_2D. This leads to the equation, which is valid up to about 500°K, $K_g = 0{\cdot}781e^{198/T}$. This equation is in good agreement with calculations based on the spectra of PH_3 and PD_3 and the rule of the geometric mean. A.

541.123.5

9109. Theory of ionic exchange equilibria. W. SAKAI AND T. SEIYAMA. *Mem. Fac. Engng Kyushu Univ.*, **13,** 95–117 (*No.* 1, 1952).

From a statistical thermodynamical treatment based on chemical equilibrium, the equilibrium constant K of an ion exchange system is found to be a function of the unexchanged ionic fraction in the ion exchanger. Results obtained by the authors and by other workers are interpreted using this theory and the relationships between the chemical equilibrium equation derived and adsorption equations are discussed.

G. I. W. LLEWELYN

541.124

9110. On the theory of chemically reacting gas. K. TAKAYANAGI. *Progr. Theor. Phys.*, **6,** 486–97 (*July–Aug.*, 1951).

The method of determining the molecular velocity distribution in steady reaction in homogeneous gas phase with negligible reaction heat is formulated, and the case where one of the reacting molecules is very light is studied in detail. In this case the perturbation of the distribution function by the chemical reaction becomes most remarkable, and the expansion by the Sonine's polynomials is not always useful. Even then, the correction to the reaction rate is very small except for the most unfavourable case and therefore the Maxwellian distribution may be used to calculate the reaction rate. A.

541.124

9111. Activation energies and frequency factors in the thermal decomposition of paraffin hydrocarbons. M. G. PEARD, F. J. STUBBS AND C. HINSHELWOOD. *Proc. Roy. Soc. A*, **214,** 471–81 (*Oct.* 9, 1952).

Further evidence supports the view that the thermal decomposition of paraffin hydrocarbons occurs by simultaneous chain and non-chain (molecular) mechanisms, the latter being isolated by addition of suitable inhibitors such as nitric oxide. It is concluded that certain small surface effects are secondary disturbances of an essentially homogeneous reaction. With one group of hydrocarbons, type 1, the activation energy is independent of the initial pressure. In a second group, type 2, the molecular reaction seems to be a superposition of two unimolecular reactions, and there is a marked variation with pressure of the apparent activation energy. This apparent activation energy is influenced by the addition of certain gases (propylene, ethane, propane) in such a way as to be in any given case a unique function of the total pressure of paraffin plus added gas. The frequency factors in the equation $k = A\,e^{-E/RT}$ have been determined. With the paraffins of type 2, the "high-pressure" components of the reaction give values within the range expected by the theories which relate A to a vibration frequency, and assume the localization of the critical energy in a single bond. With some of the paraffins of type 1 the frequency factors are outside the probable range (10^{12} to 10^{14} s^{-1}), and the values suggest that the transition states may be less sharply defined than the localization condition demands. The apparent values of the frequency factors associated with the "low-pressure" components of the reactions are still higher and appear to demand a special interpretation which must be the subject of further investigation. A.

541.124 : 541.57

9112. Hydrogen bonding and the interactions of water molecules. E. S. CAMPBELL. *J. Chem. Phys.*, **20,** 1411–20 (*Sept.*, 1952).

A study of proposed explanations for the forces governing the interaction of hydrogen-bonded molecules has been made by investigating various models for the intermolecular potential function for H_2O. Implications of the models concerning the known properties of H_2O have been examined. After a survey of existing views and data on hydrogen bonding, the electrostatic model is chosen for further study. The criterion selected to winnow the proposed models is their ability to correlate second virial data and the energy of sublimation of ice. The dipolar energy of

ice is calculated after Ewald and Kornfeld. Although the dipole approximation fails to pass the first test, it is sufficient for interesting observations on some crystal properties of ice. The consistency of the dipole model with Pauling's explanation of the entropy discrepancy is examined. Point charge models are discussed and a multipole calculation made for the ice structure with the highest dipole–dipole energy. Calculations made suggest that a properly chosen point charge model may suffice for the correlation of gas and crystal data. A.

541.126 : 535.338

9113. Kinetics of OH radicals from flame emission spectra. V. A study of the acetylene–oxygen flame. K. E. SHULER AND H. P. BROIDA. *J. Chem. Phys.*, **20**, 1383–8 (*Sept.*, 1952).

For Pt IV, see Abstr. 3061 (1952). The inner cone of the acetylene-oxygen flame burning lean (1 : 5), stoichiometric (2 : 5), and rich (4 : 5) at atmospheric pressure has been studied spectroscopically with the object of gaining some information about the elementary processes occurring in this flame. The rotational, vibrational, and electronic distributions of $OH(^2\Sigma^+)$ have been determined for each fuel mixture. The analysis of the data showed a rotational Maxwell–Boltzmann distribution with a rotational "temperature" several hundred degrees higher than the adiabatic flame temperature. The vibrational distribution of $OH(^2\Sigma^+)$ was distinctly nonequilibrium with an excess population in the level $v' = 3$ analogous to that observed for the hydrogen-oxygen flame. This is attributed to the interaction of the $^2\Sigma^+$ and $^2\Sigma^-$ states of OH. The analysis of the electronic distribution of OH indicated that $OH(^2\Sigma^+)$ is present in its thermal equilibrium concentration in the flame at atmospheric pressure. The results of this study in conjunction with the work of Gaydon and Wolfhard on the low pressure acetylene–oxygen flame indicate that the radiation of $OH(^2\Sigma^+)$ is to a large extent chemiluminescence so that a considerable fraction of the excited hydroxyl radicals must have been formed in the $^2\Sigma^+$ state by a chemical reaction (or reactions). A.

541.127

9114. The use of nuclear induction in the kinetic study of the reaction $Eu^{+3} + e \rightarrow Eu^{+2}$. T. W. HICKMOTT AND P. W. SELWOOD. Letter in *J. Chem. Phys.*, **20**, 1339 (*Aug.*, 1952).

Plotting Eu^{+2} concentration (formed by reduction in solution by metallic Zn) against time showed initially a zero–order reaction with $k = 1{\cdot}54 \times 10^{-4}$ mole litre^{-1} sec^{-1}; the rate controlling is probably the desorption of Eu^{+2} from the zinc surface, later the diffusion of reactant on to the surface. J. JACOBS

541.128 : 541.183

9115. Electronic barrier layer phenomena in chemisorption and catalysis. P. B. WEISZ. *J. Chem. Phys.*, **20**, 1483–4 (*Sept.*, 1952).

Chemisorption processes lead to interactions between electrons in the chemisorbed molecules and the electronic structure of the solid. Resulting electronic boundary layer phenomena are closely analogous to those studied in rectifier theory. Analysis by the methods of rectifier theory explains the variation of heat of adsorption with the amount adsorbed, gives the temperature dependence of chemisorption, and yields the increase of activation energy with frequency factor commonly observed in catalysis. A.

ELECTROCHEMISTRY 541.13

541.135 : 532.77

9116. On strong electrolytes in solutions. S. N. BAGCHI. Note in *Naturwissenschaften*, **39**, 299–300 (*No.* 13, 1952).

Recently Dutta [Abstr. 5380 (1952)] had pointed out that the distribution formula derived by Wicke and Eigen [Abstr. 3967 (1952)] is the same as that already derived by Dutta and Bagchi [Abstr. 7559 (1950)] from rigorous statistical mechanical considerations. The accompanying reply of Wicke and Eigen [Abstr. 5381 (1952)] is now shown to be relevant to the distribution formula derived earlier by Bagchi (1950), and not to the later Bagchi–Dutta distribution formula. The argument is supported by agreement between observed and calculated data. H. H. HODGSON

541.135.5 : 621.355

9117. The active iron electrode in alkaline solution. H. WINKLER. *Dtsch. Elektrotech.*, **6**, 355–9 (*Aug.*, 1952) *In German.*

Theory of the electrode in alkaline solution is discussed, prior to a description of methods for testing secondary cells. A new process is given for the preparation of electrochemical active Fe, by the hydrogen reduction of Fe_2O_3 at 500°. The problem is considered as to the conditions whereby Cd may be replaced by Fe for negative electrodes in alkaline accumulators. The electrochemical behaviour of such Fe electrodes is then described both with and without additions. It is shown that small amounts of S when present in the Fe as sulphide, may be the cause of the activity. Theoretical considerations based on the shape of the charge and discharge curves establish that the charging process occurs in two stages. There are 20 refs, 5 data tables, and 6 illustrations. H. H. HODGSON (RR

541.135.2

9118. New method for the determination of the differential capacity. A. RÍUS AND A. MARÍN GÓRRIZ. *An. Real Soc. Esp. Fis. y Quim.*, **47**(A), 5–10 (*Jan.–Feb.*, 1952) *In Spanish.*

A technique for the direct determination of the differential capacity of the electrical double layer in the mercury/oxygen free solution, is described. It requires the use of an impedance bridge and a mercury jet electrode. The accuracy is higher than 1% in solutions up to 0·1 N under conditions more suitable than those of the previously described techniques. The results are in good agreement with those obtained by methods involving a more careful cleaning of the apparatus. A

541.135.2

9119. Theory and calculation of the cathodic current distribution in galvanic electrolytes. J. STEINER. *Z. phys. Chem.*, **200**, 53–69 (*July*, 1952) *In German.*

A formula is established for the quantitative

clusion of the influences on current distribution in lvanic electrodes for every spatial arrangement d form, which is based on theoretical relationships d experimental data. The chemical composition of e electrolyte need not be known. This formula ables the current distribution to be calculated from e current density–cathode potential curve, by means f a definite spatial arrangement. Factors which pair the accuracy of the formula are qualitatively vestigated and limiting errors are indicated by omparative measurements. In ~80% of the cases kamined, the error is < ±5%. 8 illustrations.

H. H. HODGSON

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14/.15

541.14 : 578.088.2 : 534.23

Biological and chemical processes in a field of ultrasonic waves. *See Abstr.* 8023

541.15

9120. The presumed distribution of ions and excited groups in liquids. L. H. GRAY. *J. Chim. Phys.*, **48**, 172–8 (*March–April*, 1951).

This is a discussion on the primary processes which take place when liquids are exposed to ionizing radiations. The distribution of ions in and near the geometrical beam is considered for various energies, mainly from the work of E. J. Williams and of Lea. An account is given of work in the author's laboratory concerning dissipation of energy of excitation in air and water, from a 2-MeV electron beam. The dispositions of ions in the tracks of an α-particle, a 1-kV and a 60-kV electron, are compared and contrasted. The author's curves showing the relative efficiencies of ionizing radiations for the various cell-destruction processes, are shown and discussed.

D. V. MABBS

541.15

9121. The decomposition of fatty acids by alpha particles. W. L. WHITEHEAD, C. GOODMAN AND I. A. BREGER. *J. Chim. Phys.*, **48**, 184–9 (*March–April*, 1951).

The decomposition by α-particles of long-chain fatty acids up to C_{30} are described with curves showing the relationship of CO_2, CO, H_2O and H_2 formed to the number of C-atoms in the chain. At higher molecular weights, dehydrogenation appears to be more important than decarboxylation. It is suggested that hydrocarbons present in crude oil could have been produced by α-particle bombardment of fatty acids.

C. B. ALLSOPP

541.15

9122. Role of oxygenated radicals in oxidations and reductions caused by ionizing radiations. I. The cerous-ceric system. M. HAISSINSKY, M. LEFORT AND H. LE BAIL. *J. Chim. Phys.*, **48**, 208–12 (*March–April*, 1951) *In French.*

In acid solution, ceric salts are reduced by X-rays and by α-particles; cerous salts in alkaline solution are oxidized. There is no oxidation in the first case and no reduction in the second. The yield is higher with X-rays than with α-particles, and reduction is diminished in the presence of H_2. The results indicate that oxygenated radicals are more important than H-radicals in radiation-induced reactions.

C. B. ALLSOPP

541.15

9123. Difference of Szilard–Chalmers yields of Ir^{192} and Ir^{194} in neutron bombardment of sodium chloroiridiate. U. CROATTO, G. GIACOMELLO AND A. G. MADDOCK. *Ric. Sci.*, **22**, 265–9 (*Feb.*, 1952) *In Italian.*

The yields of the Szilard–Chalmers separations of Ir^{192} and Ir^{194}, produced by the (n, γ) process in sodium chloroiridiate, are 53–54% and 60–63% respectively. Since about 25% of the Ir^{192} is formed by the decay of Ir^{192*}, and this process should generally lead to molecular rupture, the greater yield of the Ir^{194} must mean that the average Ir^{194} recoil is either more likely to destroy the chloroiridiate ion or less likely to cause re-entry of another chloroiridiate ion than is the Ir^{192} recoil.

A.

541.15

9124. Decomposition of organic matter by recoil atoms from an adjacent phase. D. F. SANGSTER AND J. WRIGHT. Letter in *Nature* [*Lond.*] **170**, 368 (*Aug.* 30, 1952).

During irradiation of powdered graphite mixed with powdered uranium dioxide in the Harwell BEPO pile, 1600 times more gas was evolved than from graphite alone or 16 times more than from uranium dioxide alone. It is attributed to the decomposition of organic matter (nature unknown) in the graphite phase by fission fragments from the uranium dioxide phase.

C. B. ALLSOPP

541.15

9125. Theoretical view on "hot atom chemistry." P. C. CAPRON AND Y. OSHIMA. *J. Chem. Phys.*, **20** 1403–10 (*Sept.*, 1952).

Considering only collisions of the "billiard ball" type the total retention is obtained as a sum of partial retentions for an infinite number of collisions. Expressions are derived which give the retention as a function of the initial energy of the recoil atom. The calculation shows that it is not possible to determine the initial recoil energy by the retention.

A.

541.15 : 539.16.08

9126. Chemical dosimetry using ferrous and ceric sulphates. J. WEISS. *Nucleonics*, **10**, 28–31 (*July*, 1952).

The ferrous sulphate dosimeter depends upon the oxidation of Fe^{2+} ions to Fe^{3+}, the estimated yield being 15·4 μmoles/litre/1000 rep in aerated 0·8 N H_2SO_4 solution in pure water. This is independent of Fe^{2+} concentration, radiation dose rate between 1/50 to 200 r/sec and quantum energy between 100 keV and 2 MeV (γ-rays). Fe^{3+} ion concentration is determined from the optical density of the solution at a 304 mμ absorption peak. Beyond 50 000 rep the rate of yield of Fe^{3+} ions falls, due to consumption of the original dissolved oxygen. The ceric sulphate dosimeter does not suffer from this drawback and can be used up to $1·2 \times 10^7$ rep. The radiation reduces Ce^{4+} ions to Ce^{3+}, the sensitivity of the reaction being only about one sixth of the Fe^{2+} oxidation. The residual Ce^{4+} ions in solution can

be determined from optical density (320 mμ absorption peak) and the Ce^{3+} yield deduced. The yield is independent of quantum energy, Ce^{4+} concentration and dose rate between ½ and 500 r/sec. Experiments on the effect of the walls of the container are discussed. L. R. SHEPHERD

541.15 : 541.64

9127. Polymerization as a guide to track distribution. F. S. DAINTON. *J. Chim. Phys.*, **48**, 182–3 (*March–April*, 1951).

The kinetics of polymerization reactions initiated by H or OH radicals formed during X- or γ-irradiation, when the radicals are initially localized along ionization tracks, differ from those of the same reactions when the radicals are generated throughout the whole volume. When the tracks are widely distributed, polymerization chains will reach their full length before overlapping; but as the tracks become closer together (e.g. at higher dosage rates), overlapping will increase and the conditions resemble those of general distribution. Relative track separations for different radiations can thus be deduced from studies of kinetics. C. B. ALLSOPP

DISPERSIONS . COLLOIDS . ADSORPTION 541.18

541.182.6

9128. A rigorous, simple method of measuring and recording particle-size distribution in dispersed material. M. RIM. *Trans Amer. Geophys. Un.*, **33**, 423–6 (*June*, 1952).

In all conventional methods measuring gear is present in a suspension of settling particles, causing inhomogeneity and gravitational instability. Here an apparatus is described where only external measurements (buoyancy) have to be taken on a column of settling particles, and stability is rigorously maintained by the employment of an additional liquid. The design is simple enough to make this method not only suitable for reference purposes but also equipment- and effort-saving in routine determinations. It was combined with a bead-recorder, necessitating no photographic work and almost no mechanical parts. A.

541.183 : 541.128

Electronic barrier layer phenomena in chemisorption and catalysis. *See Abstr.* 9115

CHEMICAL STRUCTURE 541.2/.6

541.265

9129. Parachors of certain inorganic compounds. C. P. AGARWAL. *Z. phys. Chem.*, **200**, 20–5 (*July*, 1952).

Parachors are measured of SO_2Cl_2, CrO_2Cl_2 and CrO_3. The values found (194·5, 192, 79·7 resp.) are lower than can be explained by the assumptions that the parachor of a molecule is the sum of the parachors of its atoms and its bonds, and that a covalency of four is the maximum number possible for one atom. It is concluded that the compounds mentioned have a different bonding scheme, and that more than eigh valency electrons may take part in the bonding of th central atom. A. J. TAYLO

541.5 : 535.343.2–1

9130. Some reactions in the solid state, studied b means of infrared absorption spectra. C. DUVAL AN J. LECOMTE. *C.R. Acad. Sci.* [*Paris*] **234**, 2445– (*June* 16, 1952) *In French.*

Examples are given illustrating the use of infrare techniques in distinguishing chemical and physic binding in the solid state. H. H. GREENWOO

541.5

9131. Remarks on some ideas of theoretical chemistr considered from a geometric point of view. R. DAUDE *C.R. Acad. Sci.* [*Paris*] **235**, 50–2 (*July* 7, 1952) *French.*

A new definition is suggested for the bond betwee two atoms and their coordination numbers, based o the values of atomic distances and angles, as foun in a great number of molecules. A nomenclature i introduced. In this way difficulties raised by th indistinguishability of electrons and their delocaliza tion would be avoided. A. J. TAYLO

LABORATORY APPARATUS 542.1/.7

542.48 : 541.123.2 : 539.155.

9132. The separation of binary mixtures. A KLEMM. *Z. Naturforsch*, **7a**, 417–21 (*June*, 1952) *I German.*

The time-dependent partial differential equation for fractionation columns is solved for the case of an infinitely long separation tube closed at one end fo the general case of an arbitrary initial concentration (constant along the tube). Curves of the separation factor at the closed end as function of time are give for various initial concentrations. For the limiting cases of small and large initial concentrations th results are compared with those applying to finit tubes. The method follows a procedure used b Majumdar in his treatment of tubes of finite length [Abstr. 4626 (1951)]. H. LONDO

CHEMICAL ANALYSIS 543/545

544.65

9133. Simple apparatus for measurement of fluore scence on filter-paper strips. K. SEMM AND R. FRIED Note in *Naturwissenschaften*, **39**, 326–7 (*No.* 14, 1952) *In German.*

Substances such as Vitamin B1 can be separate by ionophoresis and their amounts measured by th fluorescence in filtered ultra-violet. S. T. HENDERSON

545.721 : 621.317.49

9134. A simple magnetic oxygen meter. A. NAU MANN. *Arch. tech. Messen, Issue No.* 197 (*Ref.* V723- 17) 123–6 (*June*, 1952) *In German.*

The importance of oxygen measurement in indus trial combustions is discussed, and a new type o meter described in detail. It functions by means of a magnetic mechanism based on the paramagneti

roperty of the oxygen molecule. The service forded by the meter is discussed in connection with ossible errors and their compensation. There are 5 illustrations including 8 data curves.

H. H. HODGSON (R)

545.822

9135. Differentiation, by means of infra-red absorption spectra, of calcium carbonates. J. LOUISFERT AND P. POBEGUIN. C.R. *Acad. Sci.* [*Paris*] **235**, 287–9 (*July* 28, 1952) *In French.*

Differences in the vibration frequencies of the CO_3'' ion in the region 8–15 μ for 3 crystalline forms, morphous $CaCO_3$ and $CaCO_3 . 6H_2O$ and of ixtures of these, are suitable for analysis; in partiular for the identification of the carbonate forms in he shells of molluscs. G. F. LOTHIAN

545.822

9136. A flame photometer for routine biochemical use. R. L. WARREN. *J. Sci. Instrum.*, **29**, 284–6 (*Sept.*, 1952).

The instrument is designed primarily for the determination of Na and K in fluids. The sample is atomized with compressed O and sprayed directly into an oxygen-butane flame. The photometer employs narrow band filters and emission type photocells, a separate cell being used for sodium and potassium respectively, of different spectral sensitivity. The primary photocell current is amplified and its value obtained from a potentiometer reading. Calibration is substantially linear at the routine sample concentration of 3–7 p.p.m. of either element. A.

545.822

9137. Micro analysis of solutions by arc of alternating currents. T. YAMAGUTI AND M. NISHINO. Note in *J. Phys. Soc. Japan*, **7**, 118–19 (*Jan.–Feb.*, 1952).

Briefly describes a technique for detection of Li, Cd, K and other metals, in solution. Detectable amounts are claimed to be 0·01, 0·00006 and 500 p.p.m. for Li, Cd and K respectively. The last result could be improved upon, it is suggested, by the use of more sensitive plates. J. D. CRAGGS

545.824

9138. On the quantity of the crystallographic varieties of titanium oxide. C. LEGRAND. *J. Rech. Cent. Nat. Rech. Sci.*, **4**, 181–3 (*June*, 1952) *In French.*

The proportions of rutile and anastase in a mixture are determined by an X-ray reflection technique, using standard mixtures as a reference. As little as 0·5% of anastase in rutile can be detected. J. THEWLIS

545.824

9139. X-ray spectroscopy as a control method in the production of zirconium and hafnium. D. M. MORTIMORE AND P. A. ROMANS. *J. Opt. Soc. Amer.*, **42**, 673–6 (*Sept.*, 1952).

A method developed for routine analysis of mixtures of Zr and Hf oxides in the range of concentrations from 0·5 to 99·5% Hf in Zr. The method makes use of the newly perfected X-ray fluorescence analysis equipment incorporating a Geiger tube together with associated scaling and recording circuits for measurement of intensities. A single analysis requires 5 to 10 min to complete, including preparation of sample and final calculations. The average percent deviation at concentrations of 1% Hf is 3·3% and at 40% Hf about 0·5%. A.

CRYSTALLOGRAPHY 548

548.0 : 535.55

9140. Photo-elastic properties of crystals: some new results. S. BHAGAVANTAM. *Acta Cryst.*, **5**, 591–3 (*Sept.*, 1952).

The non-vanishing photo-elastic constants in the C_3, S_6; C_{3h}, C_6; C_{6h}; C_4, S_4, C_{4h} crystal classes are given. Differences between them and those given earlier by Pockels for these classes are pointed out. Some interesting results, which are capable of being verified by experiment, are deduced. A.

548.0 : 539.32

9141. Third order elastic coefficients of isotropic solids. T. S. G. KRISHNA MURTY. Letter in *Curr. Sci.*, **21**, 8 (*Jan.*, 1952).

See Abstr. 627, 3999 (1952). It is stated, without proof or discussion, that the independent third-order elastic coefficients have the subscripts 111, 112, 144, 166, 123, 456 in the cubic system and that for isotropic solids the last three can be expressed in terms of the first three: $C_{166} = 3C_{111} - C_{112}$, $C_{123} = 2C_{112} - C_{144}$, $C_{456} = 2(C_{166} - C_{144})$. A. J. C. WILSON

548.24

9142. Twinning structure in crystals of tungsten trioxide. R. G. RHODES. Letter in *Nature* [*Lond.*] **170**, 369 (*Aug.* 30, 1952).

548.32

9143. The graphitization of diamond and the nature of cliftonite. H. J. GRENVILLE-WELLS. *Mineral. Mag.*, **29**, 803–16 (*March*, 1952).

Diamond heated to ~2000°C is wholly or partly converted to graphite, with graphite [0001] parallel to diamond [111]—the orientation to be expected from their structural relations. The mode of formation of natural graphitized diamonds and cube-shaped nodules of graphite in meteors is inconclusively discussed; the latter are probably not pseudomorphs after diamond. A. J. C. WILSON

548.33

9144. Polymorphism of $ND_4D_2PO_4$. E. A. WOOD, W. J. MERZ AND B. T. MATTHIAS. Letter in *Phys. Rev.*, **87**, 544 (*Aug.* 1, 1952).

See also Matthias [Abstr. 2672 (1952)]. $NH_4H_2PO_4$ and $ND_4D_2PO_4$ are different from the isomorphous XH_2PO_4 or XD_2PO_4 (X = K or Rb); all these salts go through a polymorphic transformation, but below this temperature K and Rb salts become ferroelectric, whilst the others do not. It is indicated that a hydrogen bond rearrangement occurs in the ammonium salts. A detailed crystallographic analysis, involving optical and X-ray experiments, is given. A. J. TAYLOR

548.33

9145. Anomalous properties in quartz. I. McDowall and W. Vose. Letter in *Nature* [*Lond.*] **170,** 366 (*Aug.* 30, 1952).

A form of quartz has been found which gives a sluggish $\alpha \rightleftharpoons \beta$ transformation at a slightly lower temperature than the normal, but otherwise its properties are normal. A. R. STOKES

548.33

9146. Abnormal thermal behaviour of α-quartz from some New Zealand soils. M. Fieldes. Letter in *Nature* [*Lond.*] **170,** 366–7 (*Aug.* 30, 1952).

The thermal pattern of this quartz shows an abnormally small peak at the normal temperature of 573°C; this can lead to errors in estimations of quartz by the thermal method. A. R. STOKES

548.5

9147. Crystal growth ideas and crystallographers. H. E. Buckley. *Proc. Phys. Soc.* [*Lond.*] *B,* **65,** 578–9 (*Aug.*, 1952).

The writer expresses doubts about the general applicability of current theories of growth of crystals around screw dislocations. A. R. STOKES

548.5

9148. Preparation of bicrystalline lead plates. F. W. Burgman and T. J. Tiedema. Letter in *Appl. Sci. Res. A,* **3,** 250–2 (*No.* 3, 1952).

Strips of 1 mm thick cold-rolled lead are grown into crystals from the molten state by gradual withdrawal of the strips from a furnace. Sections of the strip are given a predetermined orientation by initiating the growth from oriented seeds produced in a preliminary crystallization. J. A. FRANKS

548.5

9149. The transition layer between growing crystals and their solutions. Z. Gyulai and S. Bieleck. *Acta Phys., Hungarica,* **1,** 199–207 (*No.* 3, 1952) *In German.*

The idea of a partially-ordered transition layer is discussed, and certain features of faces of growing crystals are explained in terms of this idea.

A. R. STOKES

548.574 : 535.5

9150. The use of polarized light for the examination of etched metal crystals and their orientation. P. Dunsmuir. *Brit. J. Appl. Phys.,* **3,** 264–7 (*Aug.*, 1952).

Draws attention to the use of polarized light as an additional tool in studies of the orientation of etched metal crystals by goniometric methods. Observation of the state of polarization of the reflected light enables single and multiple reflections to be distinguished in cases where this ambiguity exists. Furthermore, in specific cases the orientation of crystallographically etched crystals may be determined by inferring from the reflected polarized light whether single or multiple reflection has occurred. This polarized light method uses simple apparatus and is of greatest use where a certain orientation is known to be preferred, as in the case of cold-rolled silicon iron alloys. Choosing an appropriate section for examination, inspection shows whether the expected orientation is indeed achieved. The whole procedure is extremely rapid. A.

548.58

9151. The dependence on its particle size of the heat of solution of an ionic crystal. O. Emersleben. *Z. phys. Chem.,* **200,** 1–19 (*July*, 1952) *In German.*

This is calculated using earlier equations [Abstr. 6167 (1952)] and compared with earlier experiments on NaCl type crystals. For cubes of side l the difference Q' between the molar heat of solution and its limit is $Q' = e^2N_0b_2/2l$, where b_2 is a constant related to the surface energy, $\pm e$ is the ionic charge and N_0 the Loschmidt number. For NaCl type crystals $Q' = 13{\cdot}0$ cal/l (l is in μ). This approximation is valid for l large compared with the lattice constant. For small l Q' is calculated, using a more general formula for the lattice energy. C. TURNER

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.77

9152. On the zero point entropy of methane crystal. T. Nagamiya. *Progr. Theor. Phys.,* **6,** 702–13 (*Sept.–Oct.*, 1951).

Possible crystalline structures are suggested for the low temperature modifications of CH_4, CD_4 and CH_3D crystals from the consideration of interatomic distances, assuming that the molecules are vibrating rather than rotating in the crystals. The degrees of degeneracy of several lowest eigenstates of the molecular motion are investigated by group-theoretical considerations on the simplifying assumption that each molecule is subjected to a field of a certain symmetry, namely, of octahedral, tetrahedral, trigonal, or of no symmetry. It results that the lowest rotational state of the para-CH_4 molecule, $j = 2$, splits into several components in the octahedral and tetrahedral field, of which the lowest state has a degree of spatial degeneracy 4 and 2, respectively. An explanation of Clusius's measurement of the zero-point entropy of the CH_4 crystal can be given by assuming a tetrahedral field and assuming that the conversion between different symmetry types of the molecule does not occur. The alternative and more probable explanation can be given by the assumption that 12 lowest levels resulting from the symmetry operations of the molecule are quasi-degenerate and the symmetry of the field is tetrahedral or lower. The occurrence of the conversion does not matter in the latter case. The zero-point entropy of CH_3D can also be accounted for by the second type of assumption. A.

548.77

9153. Colloid and colour centres in additively coloured rock salt. W. Böhm. *S.B. Öst. Akad. Wiss., IIa,* **160,** 79–97 (*No.* 1–5, 1951) *In German.*

Rocksalt was additively coloured and then bleached by thermal treatment. Absorption spectra of crystals containing colour centres and colloidal centres were measured and from them the numbers of such centres estimated. This showed that the total number of sodium atoms in colour centres and colloidal centres remains constant during the colour changes. Direct estimation of colloidal centres in a natural weak blue

ock salt crystal gave approximate agreement with ne number obtained from the absorption spectrum.
G. F. J. GARLICK

548.7

9154. A contribution to the understanding of the nature and origin of violet-blue coloration of natural ock salt crystals. L. WIENINGER. *S.B. Öst. Akad. Viss., IIa*, **160**, 147–80 (*No.* 6–10, 1951) *In German.*

A review of previous work is given. Three groups f naturally coloured crystals are distinguished, those ontaining atomic colour centres (*F*-type), those ontaining colloidal type centres and those with ixtures of the two types. The production of these entres by α-particle irradiation and by inclusion of xcess metal is discussed. G. F. J. GARLICK

548.7

9155. A study of order–disorder changes in binary lloys. G. FOURNET. *J. Phys. Radium*, **13**, 14A–24A (*Feb. Suppl.*, 1952) *In French.*

The theory of Yvon [Abstr. 1702 (1948)] is applied o β-brass type alloys, taking into account the first nd second nearest-neighbour interaction potentials W_1 and W_2. The long range order s is determined s a function of T for various +ve and −ve values f $W_2/W_1 = x$ and the results presented graphically. For $x < 0{\cdot}354$, s decreases continuously towards ero at the critical temperature T_c, but for $x > 0{\cdot}354$ t drops abruptly at T_c from some finite value to zero. T_c increases continuously for decreasing values of x. Chipman and Warren's experimental results on β rass [Abstr. 7529 (1950)] are very well represented y the curve $s = f(T/T_c)$ for $x = 1/3$. The specific eat at T_c is also calculated in terms of x, and for $x = 1/3$ is $5{\cdot}80\,k$, agreeing well with the observed value of $5{\cdot}1\,k$. A. D. LE CLAIRE

548.7

9156. Discussion of proposed outer Brillouin zones applicable to titanium. R. L. BERRY, M. B. WALDRON AND G. V. RAYNOR. Letter in *Research* [*Lond.*] **5**, 240 (*May*, 1952).

Further discussion [see Abstr. 6153 (1950); 2241 (1952)]. The difference between the "formal" approach to Brillouin zone construction (each zone must contain 2 electrons/atom) and the "physical" approach used by the authors (each zone must contain an "interesting" number of electrons/atom) is discussed. E. P. WOHLFARTH

548.7

9157. The electrostatic energy of defect lattices, with particular reference to pyrrhotite Fe_7S_8. F. BERTAUT. Letter in *J. Phys. Radium*, **13**, 372–3 (*June*, 1952) *In French.*

Calculations, by Ewald's method, have shown that an ordered arrangement of defects provides a highly stable lattice structure, the energy difference between this and the disordered state being, for Fe_7S_8, 500–1000 times larger than usually met with in order–disorder changes. The corresponding superstructure lines are probably unobservably weak. A. D. LE CLAIRE

548.7

9158. Microscopic studies on beryl crystals. III. The movement of dislocations. L. J. GRIFFIN. *Phil. Mag.*, **43**, 827–46 (*Aug.*, 1952).

For Pt II, see Abstr. 2234 (1952). It is shown that slight anomalies in the layer pattern near a dislocation can often be interpreted only as due to movement of the dislocation over a short distance. Examples are also shown in which a single dislocation has moved and cut across neighbouring layers. Characteristic types of dislocation groups, termed limited slip-zones, which are often observed, are shown to be explicable, in all details, in terms of the "generation" of dislocations by Frank–Read sources. The type of layer structure to be observed while such a source is still active, or has just ceased to be active, is deduced and some of the cases observed are shown. A.

548.7 : 539.152.1 : 538.222

9159. On the interaction of the nuclear spin with oscillations of the crystal lattice. G. R. KHUTSISHVILI. Letter in *Zh. Eksper. Teor. Fiz.*, **22**, 382–3 (*No.* 3, 1952) *In Russian.*

The interaction between the magnetic field due to the motion of the nucleus in the electric field present in a lattice and the nuclear magnetic moment comes out too small by $\sim 10^4$ to explain the observed short relaxation times of ~ 10 sec, which must therefore be due to paramagnetic impurities. W. J. SWIATECKI

548.7 : 539.32

9160. The study of elastic waves in the body-centred cubic lattice of α iron. II. H. CURIEN. *Bull. Soc. Franç. Minér. Crist.*, **75**, 343–84 (*July–Sept.*, 1952) *In French.*

For Pt I, see Abstr. 8556 (1952). To confirm the results obtained, and to measure the atomic coefficients introduced in Pt I, measurements were made, using an ionization chamber spectrometer with a Lindemann electrometer, of the energy of X-rays diffusely scattered in various directions from single α-Fe crystals. These are employed to give, by a method due to Laval and described in the earlier paper, the frequencies ν and velocities of thermal waves propagating along the tetrad, triad and diad axes. The measured variation of ν with wavelength agrees well with the theoretical predictions. The frequency spectrum is calculated and is found to differ markedly from that of Debye. It is used to calculate the lattice specific heat of α-Fe (5·53). The difference (0·52) between this and the observed specific heat is due to the magnetic and electronic contributions. The former may be calculated, and so is obtained a value (0·34) for the latter, the direct calculation of which has not yet been satisfactorily carried out for ferromagnetics. The values obtained for the "atomic coefficients" show that the interatomic forces are not precisely central. The force between atoms decreases rapidly with their increasing separation and it is in fact sufficient, as assumed in the theory, to consider no more than 1st, 2nd and 3rd nearest neighbour interactions. A. D. LE CLAIRE

548.73/.74 : 539.26/.27

X-ray and electron investigation of materials. *See Abstr.* 9084–90

548.732

9161. The interference theory of ideal paracrystals. R. HOSEMANN AND S. N. BAGCHI. *Acta Cryst.*, **5**, 612–14 (*Sept.*, 1952).

The concept of a distorted lattice, "ideal paracrystal," and its diffraction theory lead to a generalization of other well-known interference theories

and, in particular, under certain special conditions, degenerate to the theory of crystals by von Laue and Bragg, to that of liquids by Debye and Menke and Zernicke and Prins, and to that of amorphous matter by Guinieren–Warren–Hosemann. A.

548.732

9162. The energy flow in X-ray interference in crystals. M. v. LAUE. *Acta Cryst.*, **5**, 619–25 (*Sept.*, 1952) *In German.*

It is shown how the dynamical theory of X-ray diffraction accounts for the experimentally observed path of the X-ray energy through thick crystals set at reflecting positions. This path is determined only by the nature of the crystal and the wavelength of the X-rays, and is due to the anomalous absorption of the X-rays incident at the Bragg angle. A.

548.732

9163. The interpretation of diffuse X-ray reflexions from single crystals. J. HOERNI AND W. A. WOOSTER. *Acta Cryst.*, **5**, 626–30 (*Sept.*, 1952).

A description is given of the construction and use of a $\bar{\rho}$ $\bar{\phi}$-chart whereby the angular coordinates of any line in reciprocal space passing through a reciprocal point near to the sphere of reflection can be found. An *R*-chart giving the distance from the same reciprocal point of the intersection of this line with the reflecting sphere is also given. Methods are described of using the Laue and also the Bragg reflections to locate the charts correctly with respect to an enlarged drawing of the diffuse spot. A.

548.732 : 537.531 : 535.34

9164. On the anomalous transparency of thick crystals to X-rays. W. H. ZACHARIASEN. *Proc. Nat. Acad. Sci.* [*Wash.*] **38**, 378–82 (*April*, 1952).

A comparison of the author's theory (1945) with the experiments of Borrmann [Abstr. 6528 (1950)] and Campbell [Abstr. 9821 (1951)] shows good agreement. A. R. STOKES

548.733

9165. An oscillating specimen holder for an X-ray microbeam camera. P. GAY AND A. KELLY. *J. Sci. Instrum.*, **29**, 287–8 (*Sept.*, 1952).

A specimen holder is described which provides for the selection and oscillation of areas of specimens to be illuminated by an X-ray microbeam. A.

548.733

9166. A fast scanning mechanism for use with a Geiger counter X-ray spectrometer. J. ADAM. *J. Sci. Instrum.*, **29**, 324–5 (*Oct.*, 1952).

A specimen scanning mechanism designed for use with a Geiger counter X-ray spectrometer is described. Its special feature, the stability of movement at high scanning speeds, is achieved by using steel rods as guides for moving parts. The scanning frequency is approximately 150 per min. A.

548.734

9167. Considerations of the effect, when using a divergent beam, of the geometry of the apparatus on the form of Debye–Scherrer Hull spectra from a transparent cylindrical specimen. C. STORA. *J. Phys. Radium*, **13**, 339–46 (*June*, 1952) *In French.*

Lihl's equations (1932) are used to find the intensity distribution of a Debye–Scherrer line; it is the result of superimposing a family of ellipses, and depends on the radii of specimen and film, entrance slit width, slit-to-specimen distance, and angle of diffraction.

A. R. STOKES

548.73[illegible]

9168. X-ray crystallographic study of the α-tri[illegible] calcium phosphate/calcium carbonate mixture. C. LEGRAND, J. BARRAUD AND P. CARTIER. *C.R. Acad. Sci.* [*Paris*] **234**, 2624–5 (*June* 30, 1952) *In French.*

It is shown, in connection with studies of bone, that one cannot generally detect $CaCO_3$ powder lines if the proportion of $CaCO_3$ is less than 10–15%.

A. R. STOKES

548.734.2

9169. Laue asterism and deformation bands. E. A. CALNAN. *Acta Cryst.*, **5**, 557–63 (*Sept.*, 1952).

From X-ray and optical observations on Al single crystals in tensile deformation it is shown that the asterism in the usual type of Laue patterns is associated with macroscopic misorientations of the crystal. The changes of orientation may be ascribed to two distinct types of deformation bands, the kink bands previously reported by Cahn and others, and lamellar regions where the primary slip system is less marked and additional systems operate. The nature of these latter bands is discussed in relation to current ideas on inhomogeneous deformation. A.

548.734.84

9170. An extension of the use of intensity statistics. H. LIPSON AND M. M. WOOLFSON. *Acta Cryst.*, **5**, 680–2 (*Sept.*, 1952).

The description, given by Taylor, of the optical basis of Wilson's statistical method for detecting centrosymmetry in a crystal suggests that there are certain conditions under which exceptions may arise. One of these exceptions—a structure with centrosymmetrical molecules arranged centrosymmetrically—gives a more extreme distribution of intensities than does an ordinary centrosymmetrical structure. It is proposed to call this distribution "hypercentric," and its recognition may lead to useful preliminary information at the outset of a structure determination. The theory of the hypercentric distribution is discussed, and some examples of crystals in which it occurs are given. A.

548.735

9171. Thermal vibrations in cubic crystals. M. S. AHMED. *Acta Cryst.*, **5**, 587–91 (*Sept.*, 1952).

The relationships between the diffuse spots and non-radial streaks on "diffuse" Laue photographs, and their signficance in terms of the Waller–Jahn theory and the state of binding of the atoms, have been studied for cubic crystals, non-molecular and molecular in type. The elastic behaviour of LiF and its effect on the diffuse scattering of X-rays has been compared with that of KCl and other alkali halides. The results of the representation of diffuse spots in reciprocal space as anisotropic clouds around the reciprocal-lattice points, and the existence or non-existence of bridges of extra reflecting power from one reciprocal-lattice point to another, are studied for non-molecular cubic crystals and for the molecular cubic crystal $C_6N_4H_{12}$. A.

548.735.4

9172. Linear structure-factor inequalities and their application to the structure determination of tetragonal ethylenediamine sulphate. Y. OKAYA AND I. NITTA. *Acta Cryst.*, **5**, 564–70 (*Sept.*, 1952).

New linear structure-factor inequalities for crystals with centres of symmetry were derived, and the concept of arbitrariness in the systematic applications of the inequality methods introduced. Linear inequalities were applied to the U_{hk0}'s and U_{h0l}'s of tetragonal ethylenediamine sulphate (of hitherto unknown structure), and almost all the signs of important structure factors determined within a few hours. With these signs electron-density projections were synthesized from which approximate atomic positions were assigned to all atoms except hydrogen. A.

548.735.4

9173. Some practical applications of generalized crystal-structure projections. W. COCHRAN AND H. B. DYER. *Acta Cryst.*, **5**, 634–6 (*Sept.*, 1952).

The generalized projection of a periodic distribution $\rho(x, y, z)$ is defined as $c\int_0^1 \rho(x, y, z) \exp[2\pi iLz]dz$, and can be expressed as a two-dimensional Fourier series. Two practical applications of this function in X-ray analysis are described. A.

548.735.44

9174. The symmetry of real periodic two-dimensional functions. W. COCHRAN. *Acta Cryst.*, **5**, 630–3 (*Sept.*, 1952).

The symmetry of real periodic functions is considered, taking into account reversal symmetry elements which relate one point to another where the function has the same magnitude but opposite sign. There are 46 reversal space groups in two dimensions, and 3 in one dimension, which contain one or more of such symmetry elements. The number in three dimensions is not yet known. Reversal space groups can be denoted by symbols analogous to those of the Hermann–Mauguin space-group notation. A.

548.735.44

9175. Fourier strips at a 3° interval. C. A. BEEVERS. *Acta Cryst.*, **5**, 670–3 (*Sept.*, 1952).

The production of a new set of strips is described and the uses are outlined. It is thought that this set will be of considerable service in structure-factor calculation as well as in the computation of electron-density and Patterson maps, and in the calculation of molecular Fourier transforms. A.

548.735.44

9176. The use of Fourier strips for calculating structure factors. C. A. BEEVERS AND H. LIPSON. *Acta Cryst.*, **5**, 673–5 (*Sept.*, 1952).

The accuracy of the method is discussed, and some examples are given of the procedure involved. A.

548.735.46

9177. Details of the direct solution of structures by complete interpretation of Patterson space. J. L. AMORÓS. Note in *An Real. Soc. Fis. y Quim.*, **47(A)**, 37–44 (*Jan.–Feb.*, 1952) *In Spanish.*

Discussion of methods such as those of Abstr. 3517, 7613 (1950). A. J. C. WILSON

548.735.46

9178. Relations between the symmetrized Patterson function and structure. E. F. BERTAUT. *Bull. Soc. Franç. Minér. Crist.*, **75**, 401–18 (*July–Sept.*, 1952) *In French.*

See Abstr. 3207 (1951). The symmetrized Patterson function is obtained by superimposing a number of Patterson functions shifted so that their origins lie on a set of equivalent points related by the space-group of the crystal. It can also be obtained as a weighted transform of the squares of the structure amplitudes. Its properties are discussed, and its relation to Buerger's implication diagram are shown. Two applications, to Mg boroferrite and to decaborane, are described. A. R. STOKES

548.736.1

9179. Crystal chemical studies of the 5*f*-series of elements. XVII. The crystal structure of neptunium metal. W. H. ZACHARIASEN. *Acta Cryst.*, **5**, 660–4 (*Sept.*, 1952). For Pt XVI, see Abstr. 4018 (1952).

548.736.1

9180. Crystal chemical studies of the 5*f*-series of elements. XVIII. Crystal structure studies of neptunium metal at elevated temperatures. W. H. ZACHARIASEN. *Acta Cryst.*, **5**, 664–7 (*Sept.*, 1952).

548.736.1

9181. The diffuse X-ray reflections from diamond. J. HOERNI AND W. A. WOOSTER. Note in *Experientia*, **8**, 297–8 (*No.* 8, 1952).

A study has been made of the structure-sensitive extra reflections, not due to thermal diffuse scattering, which form "spikes" in reciprocal space through the reciprocal lattice points. The intensities and intensity-distributions of the spikes are tabulated. A. R. STOKES

548.736.3

9182. Interatomic distances and atomic valences in $NaZn_{13}$. D. P. SHOEMAKER, R. E. MARSH, F. J. EWING AND L. PAULING. *Acta Cryst.*, **5**, 637–44 (*Sept.*, 1952).

The crystal structure of $NaZn_{13}$ and of several homologous compounds AB_{13} was reported by Ketelaar and by Zintl and Hauke to be based on space group O_h^6–$Fm3c$, with 8 Na in 8(*a*): $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$; . . . ; 8 Zn_I in 8(*b*): 0, 0, 0; . . . ; and 96 Zn_{II} in 96(*i*): $0, y, z$; . . . . Approximate values were reported for the parameters a_0, y and z; for $NaZn_{13}$ Zintl and Hauke reported 12·27Å, 0·178 and 0·122 for these three parameters. Each Zn_I is surrounded by twelve Zn_{II} at the vertices of a nearly regular icosahedron, and each Na by twenty-four Zn_{II} at the vertices of a snub cube. Interest in the structure was largely concerned with the valences of the two different kinds of Zn atoms, it being presumptive that Zn_I has a larger valence than Zn_{II} because its icosahedral coordination requires it to be smaller than Zn_{II}. Lines on new powder photographs of $NaZn_{13}$ were measured and the intensities were estimated visually with as much precision as possible. Least-squares treatments were employed in order to obtain the best possible values for the three parameters; the values obtained are $a_0 = 12{\cdot}2836 \pm 0{\cdot}0003$Å, $y = 0{\cdot}1806 \pm 0{\cdot}0003$ and $z = 0{\cdot}1192 \pm 0{\cdot}0003$. The uncertainties given are calculated standard deviations. Analysis of the interatomic distances yields a self-consistent interpretation in which Zn_I is assumed to

be quinquevalent and Zn_{II} quadrivalent, while Na may have a valence of unity or one as high as $1\frac{1}{4}$, the excess over unity being suggested by the interatomic distances and being, if real, presumably a consequence of electron transfer. A valence electron number of approximately 432 per unit cell is obtained, which is in good agreement with the value 428·48 predicted on the basis of a filled Brillouin polyhedron defined by the forms (444), (640) and (800). A.

548.736.3

9183. The formation of order in the alloy $AuCu_3$. I. G. EDMUNDS AND R. M. HINDE. *Proc. Phys. Soc.* [*Lond.*] *A*, **65**, 716–30 (*Sept.*, 1952).

The approach to order in $AuCu_3$ has been studied by X-ray examination of single crystals. The distribution of intensity in the diffuse super-lattice reflections was measured from a series of photographs of a stationary crystal, and again from a moving-film photograph, the effect of instrumental broadening being eliminated by Stokes' method. The intensity in the *hkl* reflection with $(k + l)$ even is given as the Fourier summation $I(uvw) = \Sigma\Sigma\Sigma K \exp[-(\beta x^2 + \alpha y^2 + \alpha z^2)] \exp 2\pi i(xu + yv + zw)$; the constants α and β tend to zero as complete order is approached. The experimental results of Strijk and MacGillavry conform to this expression, and a measure of agreement is obtained with Cowley's observations at a very early stage of ordering. The discrepancy between the present observations and crystal models proposed by A. J. C. Wilson is discussed, and expressions are derived for order parameters at successive short ranges. It is suggested that the ordering process is similar at all stages and depends on a tendency for Au atoms to avoid each other; ordered antiphase domains are formed as a consequence of this process. A.

548.736.4

9184. X-ray study of some ferroelectric crystals. I. The crystal structure of ammonium dihydrogen phosphate. R. UEDA. *Mem. Fac. Sci. Engng Waseda Univ.*, *No.* 14, 6–8 (1950). [Also published in *X-rays*, **5**, 21–5 (*May*, 1948), *in Japanese, with English summary*.]

See also Abstr. 6843 (1950). Tetragonal, $I\bar{4}2d$, $a = 7{\cdot}479 \pm 0$ [*sic*], $c = 7{\cdot}516 \pm 5$ Å(?), Z = 4, 16O in (*e*) with $x = 0{\cdot}083$, $y = 0{\cdot}147$, $z = 0{\cdot}125$, 8H in (*d*) with $x \sim 0{\cdot}147$. The structure differs from that of the K analogue in that the axial ratio is greater than unity and that the OH . . . O bonds are more nearly || to the (001) plane. There is one short (2·87 Å) NH_4 . . . O distance that suggests hydrogen bonding. A. J. C. WILSON

548.736.4

9185. X-ray study of some ferroelectric crystals. II. On the phase transition of barium titanate $BaTiO_3$. R. UEDA. *Mem. Fac. Sci. Engng Waseda Univ.*, *No.* 14, 8–10 (1950).

For further reference see Abstr. 4918 (1950). Above 110°C $BaTiO_3$ is cubic, with $a \sim 3{\cdot}997$ Å(?) at 110°, coefficient of volume expansion $\alpha = 3{\cdot}2 \times 10^{-5}$ per °C. Below 110°C the Debye–Scherrer lines become diffuse, then split up, indicating a tetragonal phase with a decreasing to ~3·983 at room temperature, c not measured $\alpha = 1{\cdot}9 \times 10^{-5}$ per °C by dilatometer. A. J. C. WILSON

548.736.4

9186. The unit cell and Brillouin zones of $Ni_4Mn_{11}Al_{60}$ and related compounds. K. ROBINSON. *Phil. Mag.*, **43**, 775–82 (*July*, 1952).

The compounds based on the ideal formulae $Ni_4Mn_{11}Al_{60}$ and $Cu_2Mn_3Al_{20}$ have similar structures and a prominent Brillouin zone which would be expected to contain 1·74–2·04 electron states per atom. $ZnMn_5Al_{24}$ has a different structure and a slightly smaller prominent Brillouin zone. The size of the prominent Brillouin zones is consistent with the known composition ranges of the compounds, provided the transitional metal atoms are assumed to remove loosely bound electrons from the structure as a whole, to about the extent suggested by Raynor (1944). Although the present work gives no information concerning the mechanism by which these electrons are removed, the magnitude of the effect strongly suggests that it is by absorption of otherwise free electrons into the vacancies in the 3d atomic orbitals of the transitional metal atoms. More direct evidence for this suggestion in the case of Mn atoms has been obtained by the author in the examination of the structure of the compound Mn_3SiAl_9 [Abstr. 7706 (1952)]. A.

548.736.4

9187. The crystal structure of magnesium pyroborate. Y. TAKÉUCHI. *Acta Cryst.*, **5**, 574–81 (*Sept.*, 1952).

This was studied, using rotation and Weissenberg photographs (Mo $K\alpha$, $\lambda = 0{\cdot}710$Å), by the trial-and-error and Fourier-series (2-dimensional) methods. The unit cell has the dimensions $a = 12{\cdot}10 \pm 0{\cdot}05$, $b = 3{\cdot}12 \pm 0{\cdot}02$, $c = 9{\cdot}36 \pm 0{\cdot}05$Å, $\beta = 104° 20' \pm 30'$, containing 4 molecules of $Mg_2B_2O_5$. The space group is C_{2h}^5–$P2_1/a$. The structure is composed of B_2O_2 (double-triangle) groups held together by Mg atoms which are in the middle of distorted oxygen octahedra. The B_2O_5 group is almost identical in form with one recently found by Berger in Co pyroborate, which has a structure closely related to that of Mg pyroborate. The possible explanation of the structure of $Mg_2B_2O_5$ as a polysynthetic structure has been envisaged, using the powder photographs of natural and artificial products. A.

548.736.4

9188. The crystal structure of K_2TiF_6. S. SIEGEL. *Acta Cryst.*, **5**, 683–4 (*Sept.*, 1952).

548.736.4 : 537.311.33

9189. On the variations of lattice parameters of some semiconducting oxides. L. D. BROWNLEE AND E. W. J. MITCHELL. *Proc. Phys. Soc.* [*Lond.*] *B*, **65**, 710–16 (*Sept.*, 1952).

Measurements were made of the lattice parameters of the substitutional semiconductors Ni(Li)O, $Fe_2(Ti)O_3$ and also of reduced Mg_2TiO_4. The contraction of the nickel oxide lattice, which was briefly reported by Verwey *et al.* (1950), was observed for a series of compositions; also the expansion of the Fe_2O_3 lattice associated with the production of Fe^{2} ions. Similarly, the expansion which accompanies the reduction of the spinel Mg_2TiO_4 is attributed to

he formation of Ti^3 ions. The lattice parameter of toichiometric nickel oxide is believed to be ·1726 ± 0·0002 kX (4·1811Å) while that of un-educed magnesium titanate is found to be ·425 ± 0·0005 kX (8·442Å). A.

548.736.5

9190. The structure of mercuric amidobromide. L. Nijssen and W. N. Lipscomb. *Acta Cryst.*, **5**, 504–5 (*Sept.*, 1952).

548.736.5

9191. On the structure of the paratungstate ion. I. Lindqvist. *Acta Cryst.*, **5**, 667–70 (*Sept.*, 1952).

The structure of the complex ion in $5Na_2O.12WO_3.28H_2O$ has been determined, using a new vector-algebraic method. The formula of the ion, $W_{12}O_{46}^{20-}$, has no direct relation to the analytical formula, which would require a $W_{12}O_{41}^{10}$-ion for the paratungstate to be a neutral salt. A.

548.736.5 : 535.375.54

9192. Orientation of the water molecules in the crystal $ClO_4Li.3H_2O$. L. Couture-Mathieu and J.-P. Mathieu. *Acta Cryst.*, **5**, 571–3 (*Sept.*, 1952) *In French.*

Intensity measurements of the Raman lines produced by the vibrations of the water molecules in an oriented single crystal of $LiClO_4.3H_2O$ permit the determination of the orientation of these molecules in the cell and indicate how their polarizability is affected by the surrounding atoms. A.

548.736.6

9193. Details of the structure of chrysotile. F. Pardillo and J. L. Amorós. *An. Real Soc. Esp. Fis. y Quim.*, **47**(A), 11–16 (*Jan.–Feb.*, 1952) *In Spanish.*

Some details of the X-ray diagram of chrysotile are examined by the authors after checking about one hundred specimens all over the world. Two kinds of such a mineral are found, namely chrysotile and parachrysotile. Padurow's unit cell and spatial group are in agreement with the new measurements. A.

548.736.7

9194. The structure of synthetic polypeptides. I. The transform of atoms on a helix. W. Cochran, F. H. C. Crick and V. Vand. *Acta Cryst.*, **5**, 581–6 (*Sept.*, 1952).

The formulae are given for the Fourier transforms of a number of helical structures; namely, a thin helical wire, a set of identical atoms spaced at regular intervals on a helix and the general case of a group of atoms repeated by the operation of a non-integer screw. General predictions are made concerning the intensities of the X-ray diffraction pattern of the synthetic polypeptide poly-γ-methyl-L-glutamate, assuming that its structure is based on the α-helix suggested by Pauling and Corey. A.

548.737

9195. Symmetry and physico-chemical properties of crystalline compounds. VI. Distribution of crystal structure over space-groups and general principles of formation of crystalline organic compounds. W. Nowacki. *Helv. Chim. Acta*, **34**, 1957–62 (1951).

A statistical study is made of the space-groups found in 4000 substances. The groups C_4^2–$P2_1$, C_2^5–$P2_1/c$ and D_2^4–$P2_12_12_1$ occur to the extent of 9, 22 and 10%, respectively, among the cryst. org. compounds studied. Zig-zag structure is common for these compounds. BRITISH ABSTRACTS

548.737

9196. Space group of magnesium and sodium acetates. V. M. Padmanabhan. Letter in *Curr. Sci.*, **21**, 97 (*April*, 1952).

$Mg(CH_3COO)_2.4H_2O$ is monoclinic, $P2_1/m$ [or $P2_1$ if Groth's crystal class is wrong], $a = 8·5$, $b = 11·7$, $c = 4·7$Å, $\beta = 94·9°$, $Z = 2$. $CH_3COONa.3H_2O$ is monoclinic, $C2/m$ [or $C2$], $a = 12·4$, $b = 10·5$, $c = 10·3$Å, $\beta = 112·1°$, $Z = 8$. Rotation and Weissenberg photographs with Cu$K\alpha$. A. J. C. WILSON

548.737

9197. The crystal structure of naphthalene tetrachloride, $C_{10}H_8Cl_4$. M. A. Lasheen. *Acta Cryst.*, **5**, 593–8 (*Sept.*, 1952).

548.737

9198. The crystal structure of copper proline dihydrate. A. McL. Mathieson and H. K. Welsh. *Acta Cryst.*, **5**, 599–604 (*Sept.*, 1952).

548.737

9199. On the crystal structures, residual entropy and dielectric anomaly of methanol. K. J. Tauer and W. N. Lipscomb. *Acta Cryst.*, **5**, 606–12 (*Sept.*, 1952).

The orthorhombic form of methanol has the space group D_{2h}^{17}–$Cmcm$. There are four molecules in a unit cell of dimensions $a = 6·43$, $b = 7·24$ and $c = 4·67$Å. Infinite zigzag chains of hydrogen bonds exist parallel to the (100) face. The C–O distance is 1·42Å, and the O . . . O hydrogen-bond distance is 2·66Å, indicating strong hydrogen bonds. Surrounding a particular methyl, there are two methyls at 3·88Å, four methyls at 4·01Å, two oxygens at 3·86Å and four oxygens at 4·09Å. The diffraction effects obtained from single crystals cooled through the λ point indicate that the transition is a simple displacive transformation involving a puckering of the infinite hydrogen-bonded chains, preserving the infinite chains of hydrogen bonds. The essential aspects of this transformation may be described by a monoclinic unit, containing two molecules, with $a = 4·53$, $b = 4·69$, $c = 4·91$Å and $\beta = 90$Å in the space group C_{2h}^2–$P2_1/m$, although the presence of some weak reflections suggests a superlattice. It is concluded that the residual entropy is zero, and that the dielectric anomaly is associated with the puckering of the chains discussed above. A.

548.737

9200. The crystal structure of L-glutamine. W. Cochran and B. R. Penfold. *Acta Cryst.*, **5**, 644–53 (*Sept.*, 1952).

This was determined by means of electron-density projections on the (001) and (010) planes. The (001) projection was solved by direct sign-determining methods which are described. A direct indication is obtained from a map of $(\rho_0 - \rho_c)$ of the positions of all the hydrogen atoms. Bond lengths have been measured with a standard deviation of 0·024Å and are compared with those in related structures. A correlation between the double-bond character of the C–N bond of the amide group and the reactivity of this group in glutamine and acetamide is pointed out. Cohesion of the crystal is provided by five

hydrogen bonds per molecule (the maximum number possible) extending in three dimensions and in each case linking a nitrogen and an oxygen atom. A.

548.737, 539.133

9201. The crystal and molecular structure of α-glucose. T. R. R. McDONALD AND C. A. BEEVERS. *Acta Cryst.*, **5**, 654–9 (*Sept.*, 1952).

In the elucidation of the structure, extensive use was made of the two-dimensional Patterson function. The refinement of the atomic parameters was carried out by Fourier and least-square methods. The stereochemical configuration of the molecule, as deduced on purely chemical grounds, has been directly confirmed. The pyranose ring is in the Sachse–Mohr *trans* form, and there is a *cis*-glycol grouping on C_1 and C_2. Some attempt was made to determine the interatomic bond distances with precision; there would appear to be a shortening of the glycosidic and primary hydroxyl bonds compared with the results obtained for C–O bonds in other investigations. A.

548.737

9202. Crystal chemistry of the organic molecule. J. L. AMORÓS AND M. FONT-ALTABA. *An. Real Soc. Esp. Fis. y Quim.*, **47(A)**, 267–74 (*Nov.–Dec.*, 1951) *In Spanish.*

Certain details of organic structures definitely established by means of electron density maps are reviewed, especially the possibility of locating H atoms in some structures. The results of such localization are examined in the case where no account was taken of the contribution of H atoms in the structure factor calculations. A.

548.74

9203. A new procedure for the investigation of electronic fringes from thin crystals. R. BERNARD AND E. PERNOUX. Letter in *J. Phys. Radium*, **13**, 368–9 (*June*, 1952) *In French.*

Using the electron microscope, superposition of the image of a monocrystal on a suitable diagram is made. The crystal structure of MoO_3 thus determined is in accord with previous results. G. I. W. LLEWELYN

548.74

9204. The use of the three-stage electron microscope in crystal-structure analysis. J. F. BROWN AND D. CLARK. *Acta Cryst.*, **5**, 615–19 (*Sept.*, 1952).

The combination of electron diffraction and electron microscopy in a three-stage electron microscope enables electron-diffraction patterns to be obtained from extremely small single crystals, i.e. less than 1μ across and 1000Å thick. Two examples are described in which it is shown how these single-crystal diffraction patterns can be used to obtain valuable crystallographic information concerning unit-cell size and symmetry. Thus the unit cell of the σ phase from a Cr–Ni–Mo steel was shown by electron-diffraction patterns from a micro-crystal to be tetragonal with $a = 8{\cdot}8$, $c = 4{\cdot}5$Å. The experimental difficulties and limitations are discussed and the usefulness of the method as an addition to the normal diffraction techniques for crystal-structure analysis is demonstrated, particularly in cases where the only X-ray data available are a powder photograph. A.

548.74

9205. A neutron-diffraction study of magnesium aluminium oxide. G. E. BACON. *Acta Cryst.*, **5**, 684–6 (*Sept.*, 1952).

The neutron-diffraction pattern of spinel, $MgAl_2O_4$, demonstrates that the cationic arrangement corresponds closely with the so-called "normal" structure, the scattering amplitudes of Mg and Al being sufficiently different to distinguish this from the "inverse" structure. The oxygen parameter u is 0·387. A.

548.74 : 537.533.72

9206. An electron diffraction apparatus with Geiger–Müller counters. S. LENNANDER. *Ark. Fys.*, **5**, 391–8 (*Paper* 18, 1952).

Two argon/ethyl-alcohol counters, each with a $0{\cdot}5 \times 0{\cdot}2$ mm window of $0{\cdot}25\mu$ collodion, were mounted on an adjustable slide inside an electrostatically focused diffraction apparatus. Profiles of diffraction lines were obtained by scanning with one of the counters and using the other as a monitor. Results obtained at 28 keV with an Al foil specimen are presented. Intensities can be measured more rapidly and accurately than by the photographic method. Constructional details and precautions are given. R. S. PEASE

GEOPHYSICS 55

550.311

9207. Stress and strain in the outer solid shell of the earth. A. NADAI. *Trans Amer. Geophys. Un.*, **33**, 247–76 (*April*, 1952).

With comparatively simple means, expressions are developed for the distribution of the stresses and for both components of the displacements in radial and in tangential direction over extended portions in the thin solid shell of the earth. The problem is solved for the distribution of stress and elastic strain in this thin, solid, spherical shell under the action of the tide-generating forces of the moon and sun by making use of the theory of thin, curved elastic shells. The stresses and the cyclically changing components of the elastic displacements in tangential direction permit drawing some conclusions concerning the permanent distortions to be expected in such a shell by considering the mechanical properties of the rocks under the high temperatures prevailing at the lower levels in the thin, solid shell of the earth. A.

550.341

9208. Frontal microseisms. M. H. GILMORE. *Bull. Amer. Met. Soc.*, **32**, 346–55 (*Nov.*, 1951).

The data presented in this paper concerning frontal microseisms, together with data previously published concerning tropical storm microseisms, lead to the conclusion that most microseismic storms are a direct function of the wind force, the density of the air mass involved and the area over which the

rce acts. Most reliable sources of information so lead to the conclusion that microseismic storms e generated on the ocean bottom directly under the orm area, probably by means of compressional ater waves set up by the storm. A.

550.341

209. Wave velocities in the outer part of the earth's antle. B. GUTENBERG. Letter in *Nature* [*Lond.*] 70, 289 (*Aug.* 16, 1952).

Mohorovičič's method of computing travel times f longitudinal and transverse seismic waves [*Gerlands eitr. z. Geophys.*, 13, 225 (1914)] has been applied o the observational data of *c.* 80 seisms occurring etween 1930–40 at depths from 20 to 600 km. he new values agree well with those calculated reviously from shallow-wave data; but show no ndication, as do the earlier results, of any discon-inuity over the depth range examined. They do, owever, emphasize the existence of a "low-velocity" ayer at *c.* 100 km. D. R. BARBER

550.36

9210. Heat flow through the floor of the eastern North Pacific Ocean. R. REVELLE AND A. E. MAXWELL; E. C. BULLARD. Letters in *Nature* [*Lond.*] 170, 199–200 (*Aug.* 2, 1952).

Measures of thermal gradient in the deep-sea bed at 5 locations in the eastern N. Pacific ocean show the unexpected result that the heat flow through the ocean-floor is of similar magnitude (*c.* $1{\cdot}2\times10^{-6}$ cal cm^{-2} sec^{-1}) as that through the earth's crust in continental areas. The consequences of this considerable thermal flow are discussed; and it is suggested that the most likely explanation is that, in each instance, the heat is generated by radioactivity, the total amount beneath unit area of ocean, or continent, being the same when summed to a depth of a few hundred km irrespective of vertical distribution of radioactive content which is very different in the two cases. D. R. BARBER

550.371

9211. A method of studying the distribution of electric currents in a spherical shell having non-uniform conductivity. T. RIKITAKE. *Bull. Earthquake Res. Inst.* [*Tokyo*] 26, 11–15 (1948).

An approximate method of studying the distribution of electric currents in a thin spherical shell having non-uniform conductivity is described. The current function is expressed by a sum of spherical surface harmonics. Numerical tables containing the values of a number of the occurring expansion coefficients are given. MATHEMATICAL REVIEWS

550.384

9212. The variation of the geomagnetic-activity recurrence interval with the solar cycle. E. J. CHERNOSKY. *Trans Amer. Geophys. Un.*, 32, 861–5 (*Dec.*, 1951).

A Chree-method analysis of recurrences of geomagnetic activity was made with a combination of variables heretofore unreported, using data for the years 1932–46. The results indicate that the prevailing interval between geomagnetic disturbances decreases from 28½ days at the start of a sunspot cycle to 26¾ at the end, a greater variation than the 3% previously reported. The recurrence tendency for geomagnetic activity was found to be a minimum at sunspot maximum. Unlike other analyses, this one makes use of a large range of C values in the disturbed- and in the quiet-day categories, and it breaks the sunspot cycle into groups consisting of two and three years. A.

550.389 : 551.46

9213. Magnetic anomalies over oceanic structures. F. PRESS AND M. EWING. *Trans Amer. Geophys. Un.*, 33, 349–55 (*June*, 1952).

The importance of the airborne magnetometer as a geophysical tool in the study of oceanic structures is stressed. Theoretical anomalies of the total magnetic vector are computed for typical oceanic structures to aid in the planning of aerial surveys. These structures are (1) a volcanic island, (2) a crustal fold associated with a negative gravity strip, and (3) a continental border. A.

550.93

9214. Age determination of Pacific chalk ooze by radiocarbon and titanium content. G. ARRHENIUS, G. KJELLBERG AND W. F. LIBBY. *Tellus*, 3, 222–9 (*Nov.*, 1951).

Measurements have been carried out on the average radiocarbon activity of a sediment core of eupelagic chalk ooze and the age of the lower boundary was calculated by integration of the radiocarbon decay function. In such cores where constancy of the rate of minerogenous accumulation is indicated and can be checked by lateral control, the titanium content, calibrated in terms of absolute age by means of radiocarbon measurement, can be used for dating as far back in time as the constancy of the rate of minerogenous sedimentation can be proved. A.

550.93

9215. Alpha ionization damage as a cause of low helium ratios. P. M. HURLEY. *Trans Amer. Geophys. Un.*, 33, 174–83 (*April*, 1952).

The possibility has been investigated that He atoms escape from the crystal structures of minerals only as these structures become damaged by intense α-particle ionization. The escape of He from zircon and sphene has been found to be almost zero for cases of low α bombardment, and increases progressively until almost all of the He is lost in cases where the samples have suffered a bombardment of 10^{16} α/mg. The zircons in granites are well up in the range of activity where this damage will be important, so that it is concluded that one of the principal causes of the high loss of He from granitic rocks is the concentration of the radioactive elements and consequently He into centres in which the damage will be great enough for the He to escape. The relationship between He loss and the number of α-particles per milligram has been established for zircon and sphene for use in approximate age measurements on these minerals. Theoretical curves have been derived that appear to represent the process fairly well, and permit age estimates to be made even on material that is severely damaged. A.

550.93

9216. Techniques of natural carbon-14 determination. J. L. KULP, L. E. TRYON AND H. W. FEELY. *Trans Amer. Geophys. Un.*, 33, 183–92 (*April*, 1952).

The techniques which are in use at the Lamont

Geological Observatory for the preparation and counting of the C^{14} in natural C-bearing samples are described in detail. The first phase of the process includes preparation of pure CO_2 by burning or hydrolysis, the reduction to C with hot Mg and the extraction of the product to remove all substances except the C. The yield is generally 90% of the C in the original sample with an ash content of about 1%. The C samples are mounted in a stainless-steel cylinder and counted against a background cylinder of stainless steel in a modified Libby screen-wall-type counter with an active counting length of 8 in and a dia. of 3 in. This counter is surrounded with 30- by 2-in cosmic-ray counters which are used in anti-coincidence. The entire assembly is placed in a large shield with 8 in thick iron walls. The electronic unit contains 2 regulated high-voltage supplies, drag-in voltage, monitor selector switch, anticoincidence analyser, scale of 4, and register. This arrangement has provided background as low as 2·5 counts per min. with normal operation ranging from 4 to 6 counts per min. The efficiency of the screen-wall counter is about 5%. With 3 days of counting, this arrangement can measure samples up to 25 000 yr old for wood and 30 000 yr for shells. Application of this quantitative method of age determination to a wide variety of samples of geological interest is in process. A.

551.16

9217. Cores of terrestrial planets. K. E. Bullen. Letter in *Nature* [*Lond.*] **170**, 363–4 (*Aug.* 30, 1952).

The relative merits of the models for the earth's structure of an iron core (Urey, 1951), a core due entirely to pressure modification (Ramsey, 1949) and a core partly of nickel-iron and partly of modified ultra-basic rock (Bullen, 1949) are examined in the light of observational data on Venus, Mars and Mercury. M. W. Ovenden

ATMOSPHERE . METEOROLOGY 551.5

551.508.11 : 551.551

9218. The response of balloons to the wind. D. T. Perkins. *Bull. Amer. Met. Soc.*, **33**, 135–9 (*April*, 1952).

The effect of lag in the measurement of winds by balloons is described in terms of the effective thickness of the layer through which the actual winds are averaged to obtain the balloon-measured wind. This effective thickness is expressed in terms of balloon parameters and finally in terms of the ascent rate and "lift ratio." The influence of the separate parameters on the effective thickness is discussed. A.

551.508.26

9219. Lag of bimetallic thermometers. M. Hinzpeter. *Ann Meteorol.*, **4**, 291–5 (*No.* 1–6, 1951) *In German.*

An apparatus is described for measuring the lag of bimetallic thermometers in radiosodes. A formula and nomogram are given for determining lag constant as a function of rigidity of metal, length and ventilation. METEOROLOGICAL ABSTRACTS

551.508.3

9220. Measurement of atmospheric turbulence M. Pélegrin. *C.R. Acad. Sci.* [*Paris*] **235**, 19–2 (*July* 7, 1952) *In French.*

An electrical method of measuring the speed of a movement is described and fine-scale movements an obtained by hot wire detectors. Zones of turbulenc ranging from zero to speeds of 4–5 m/s within linea distances of 7 m are found with violent local squall of smaller scale in which the speed can be 10 m/s The coefficient of turbulence can be obtained fro photographic registrations in addition to the spectru of turbulence. R. S. REA

551.508.76

9221. An instrument employing a coronal discharg for the determination of droplet-size distribution i clouds. R. Brun, J. Levine and K. S. Kleinknecht *Tech. Notes Nat. Adv. Comm. Aeronaut.*, 2458 (*Sept.* 1951).

A flight instrument that uses electric means fo obtaining a measure of the droplet-size distributio in above-freezing clouds has been devised and give preliminary evaluation in flight. An electric charge i placed on the droplets and they are separated aero dynamically according to their mass. The desirabl features of an instrument based on the metho described are: (1) the instrument can be used i clouds with temperatures above freezing, (2) th size and the shape of the cylinders do not chang during the exposure time, (3) the error caused b bounce-off is low, (4) the readings are instantaneou and continuous and (5) the fast instrument response permits the study of variations in cloud structure. METEOROLOGICAL ABSTRACT

551.508.9

9222. The field component meter. An apparatus fo the measurement of the three components of th atmospheric-electric field, and the aeroplane's ow charge when airborne. H.-W. Kasemir. *Tellus*, 3 240–7 (*Nov.*, 1951) *In German.*

An apparatus is described working on the principl of the "Feldmühle" (field strength meter) and giving simultaneous recording of the atmospheric-electri potential gradient separated in the three rectangula components of the field. Furthermore, a method i pointed out to separate the field of the own charg of the aeroplane and to record this one separately This enables the "Feldkomponentenmühle" to b used in motor-driven aeroplanes. A

551.510.4

9223. A second chloride cloud in California W. D. Crozier, B. K. Seely and A. H. Thompson. Letter in *Bull. Amer. Met. Soc.*, **33**, 177–8 (*April*, 1952).

Flights were made in Sept. 1949 in the Mojave region and collections of airborne particles made with a continuously operating impactor. On 9 occasions concentrations of chloride particles seldom exceeded 100 per m^3. On one occasion a concentration up to 10^4 particles per m^3 was found from the ground up to 10 000 ft extending across the mountains and an unknown distance out to sea. Beyond the mountains it was only in the layer 6000–10 000 ft. Air trajectories indicated that the chlorides were in air primarily from the Pacific high, but mixed with a

hall fraction from a tropical disturbance off Baja, alifornia. The Pacific high carries very few, if any loride particles in size $>10^{-13}$ g. The particle ncentration from the tropical disturbance may have ffered a dilution of about 100. R. S. READ

551.510.41 : 537.56

224. A self-consistent calculation of the dissociation oxygen in the upper atmosphere. H. E. MOSES ND T.-Y. WU. *Phys. Rev.*, **87**, 628–32 (*Aug.* 15, 1952).

In a previous paper [Abstr. 7404 (1951)] a self-onsistent model was set up for the dissociation of O n the upper atmosphere under the assumption of umber balance and radiative energy balance and a orm of the barometric equation. In the present paper similar model is used, but the requirement of diative energy balance is dropped and a temperature istribution is assumed. The resulting calculations ndicate that for this model the dissociation region is uch narrower than in the previous model and that occurs at lower altitudes. A.

551.510.5

225. On the stratification of the atmosphere. GENTILLI. Letter in *Bull. Amer. Met. Soc.*, **32**, 91 (*Dec.*, 1951).

Criticism is made of some names proposed by lohn and Penndorf and by Chapman and Gerson or subdivisions of the atmosphere. "Bottom layer" s ambiguous and "Micro layer" is better, but the Lower Friction Region" and "Upper Friction Region" are recommended. "Peplopause" is in-lefinite and "Katapause" is proposed for the layer where downward movement is blocked. "Mesosphere" s preferred to "Stratosphere" on present knowledge f this region. "Thermosphere" is of doubtful alidity because of uncertainty regarding temperature. 'Acme" or "Mesoacme" is less ambiguous, in all anguages, than "Peak" but "Ozonacme" could be sed. R. S. READ

550.510.535

226. A method of measuring the absorption of the D-layer using the Milky Way as a source of metre waves. M. LAFFINEUR AND V. KOURGANOFF. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 261–5 (*Pt II*, 1950) *In French.*

A brief account of a device based on the assumption that the "scintillation" of galactic noise is attributable to the ionosphere. It is proposed to use a helix aerial with axis parallel to that of the earth so as to embrace the same region of the celestial sphere at every instant of the sidereal day. G. M. BROWN

551.510.535

9227. Magnetic storm effects on the *F*-layer of the ionosphere. Y. V. SOMAYAJULU. Letter in *Curr. Sci.*, **21**, 21–2 (*Jan.*, 1952).

Periodic and violent fading of transmissions in India on 9·59 Mc/s during the magnetic storm of March 7, 1951, may be attributed to undulations of the point of reflection in the *F*-layer caused by rapid movements of ionic clouds in the layer. G. M. BROWN

551.510.535

9228. Studies on sporadic *E*. S. S. BARAL. *J. Sci. Industr. Res.*, **11A**, 290–6 (*July*, 1952).

Analysis of world data of E_s ionization for 1945–51, considering its nature, structure, origin and temporal and geographical variations. It appears that meteoric impacts are the main source of E_s ionization, augmented by solar corpuscles in polar latitudes, and by thunderstorm effects in equatorial latitudes. The ionized "patch" theory of E_s structure is preferable to the "thin layer" theory. The geomagnetic field appears to have some control over the intensity and frequency of occurrence of E_s echoes. G. M. BROWN

551.510.535

9229. A synopsis of ionospheric cross-modulation. L. G. H. HUXLEY. *Nuovo Cim.*, **9** (*Suppl. No.* 1) 59–89 (1952).

Detailed review, including theoretical considerations, dealing especially with post-war investigations. The phenomenon can be confidently located in the lower *E*-region, and promises to be a valuable tool for investigating the collisional frequency and detailed ionospheric structure at the 90 km level. G. M. BROWN

551.510.535 : 523.165

9230. The diffraction of galactic radio waves as a method of investigating the irregular structure of the ionosphere. A. HEWISH. *Proc. Roy. Soc. A*, **214**, 494–514 (*Oct.* 9, 1952).

The amplitudes of the radiowaves received from a radio star at two points separated by about 1 km have been studied and compared. The results indicate that the variations of phase and amplitude at one point can be ascribed to the steady drift of an irregular wave-pattern over the ground. It is shown how the structure and movement of the wave-pattern can be deduced from the observations. The irregular wave-pattern across the ground can be thought of as a diffraction pattern produced by the passage of the waves through a portion of the ionosphere which imposes irregular changes of phase on it, and it is shown how the ionospheric characteristics can be deduced. The ionospheric irregularities are shown to have a lateral extent of the order 2 to 10 km, and a variation of electron content of about 5×10^9 electrons per cm^2. It is deduced that the irregularities are at a height of about 400 km. They are most pronounced around midnight and exhibit little annual variation. The irregular portion of the ionosphere moves with a steady wind-like motion with a velocity of the order 100 to 300 m/s. The velocity decreases after midnight, and large velocities are associated with periods of magnetic disturbance. A.

551.510.535 : 523.165

Ionospheric disturbances causing flicker of radio-stars. *See Abstr.* 8635

551.510.535 : 538.566.3

Radio-wave propagation in the ionosphere. *See Abstr.* 8963–6

551.511

9231. On a differential equation of atmospheric diffusion. C.-S. YIH. *Trans Amer. Geophys. Un.*, **33**, 8–12 (*Feb.*, 1952).

Exact closed solutions of the following equation of diffusion $y^m(\partial c/\partial x) = D\partial(y^n\partial c/\partial y)\partial y$, where m and n are considered to be independent, are obtained for the following cases: (1) diffusion from a line-source embedded in a smooth surface; (2) diffusion from a smooth surface; (3) vapour concentration in the wake of an evaporating surface. The solutions for

cases (1) and (2) belong to the similarity-solution category. Dimensional analysis has been used in the systematic search for such solutions in as concise a manner as possible. The solution for case (3) can be obtained from those for cases (1) and (2). Diffusion in Couette flow is given as an example. A.

551.511 : 533.15

9232. Similarity solution of a specialized diffusion equation. C.-S. Yih. *Trans Amer. Geophys. Un.*, 33, 356–60 (*June*, 1952).

The differential equation of diffusion when the wind velocity and the vertical and lateral diffusivities are power functions of height is $y^m\partial c/\partial x = D_1\partial(y^n\partial c/\partial y)/\partial y + D_2 y^k\partial^2 c/\partial z^2$ where x, y and z are measured respectively in the down-wind, vertical and cross-wind directions, and D_1 and D_2 are physical constants defined in the text. Exact solution of this equation for the case of a point source and for $m = k$ is presented in this paper. In the systematic search for this solution, dimensional analysis has been utilized to the optimum advantage. Although the solution is restricted to the special case $m = k$, it shows the important characteristics of atmospheric diffusion from a point source. A.

551.513

9233. The balance of the absolute vorticity in the atmosphere. J. Van Mieghem. *Tellus*, 3, 297–300 (*Nov.*, 1951) *In French.*

The equation of balance is derived from V. Bjerknes' circulation theorem, formulated in an arbitrary moving frame of general coordinates. The flux and the rate of production of absolute vorticity are defined. The case of the component of absolute vorticity normal to the equiscalar surfaces of a meteorological quantity is considered. From the expression of the horizontal convective flux of the vertical component of the relative vorticity, a relation between the horizontal meridional flows of relative vorticity and angular momentum is deduced. A.

551.513

9234. A mobile method for measuring atmospheric diffusion. J. D. Sartor, I. Katz and R. E. Katz. *Bull. Amer. Met. Soc.*, 33, 188–94 (*May*, 1952).

Interest of the radio-meteorologist centres on diffusion because the vertical structure and the non-homogeneity of the atmosphere, in terms of refractive index, play a vital part in radar propagation. A portable method of measuring diffusion consists of lifting smoke-puff generators aloft with tethered balloons, setting off puffs remotely and photographing them with two motion picture cameras. From the resulting records of the areal spread of the smoke and the distance it travels, one may compute values of diffusion coefficients. Preliminary experiments yield data in accord with values published by Sutton. A.

551.521.32

9235. Recordings of nocturnal outward radiation. F. Sauberer. *Arch. Meteorol. Geophys. Bioklimatol. B*, 2, 347–59 (1951) *In German.*

Accurate measurements of effective nocturnal outward radiation were made at Vienna (1948–50) with a black sphere actinograph protected from wind by a fluorite plate. They show a slow decrease during the night, mean values are tabulated for cloudless (0·1305 cal/cm²/min) and overcast (0·0243) nights an the relation to cloudiness i is expressed in a formu involving i^2 and i which gives a much better fit tha the usual linear relation to i.

METEOROLOGICAL ABSTRAC

551.574

9236. Microwave determination of particle-size dis tribution. S. Bartnoff and D. Atlas. *Z. Meteoro* 8, 130–1 (*April*, 1951).

A preliminary note on the theory leading t research on the usefulness of microwave propagatic (attenuation) methods for determination of the liqui water content of clouds and actual drop-size distribu tion in the cloud. The reflectivity factor $Z = \Sigma N_i$ and the audio frequency spectrum $F(w)$ of pulse t pulse fluctuations have been investigated.

METEOROLOGICAL ABSTRAC

551.57

9237. Recent experiments on the effect of ultraviol light on silver iodide nuclei. B. Vonnegut an R. Neubauer. Letter in *Bull. Amer. Met. Soc.*, 3 356 (*Nov.*, 1951).

In 12 experiments AgI_2 smoke was produced b burning impregnated charcoal in a box with an u.v light in the centre. Smoke samples were tested ov 4–8 hours by introducing them into a supercoole cloud at −15°c. After allowing for the precipitatio of smoke on the walls of the box it was foun 40–100% of the AgI_2 nuclei were active after on hour's exposure to u.v. light. This differs greatl from earlier data with 10–1% in one case an 10^{-4}–10^{-7}% in another case active after one hou The cause is in doubt, but apparently AgI_2 nuclei a not necessarily adversely affected by sunlight. Th persistence of the nuclei is important for large-scal effects on cloud seeding. R. S. REA

551.57

9238. Significance of the initial radar echo. S. E Reynolds and R. Braham. Letter in *Bull. Amer Met. Soc.*, 33, 123 (*March*, 1952).

Data from New Mexico tests show that the rada echo usually appears first at about −10°c, late corrected to −13°c, and the Ohio data at abou −2°c. With the Bergeron mechanism for precipita tion particle formation the radar echo should no appear where the cloud is warmer than −5°c an where the growth rate of ice crystals by sublimatio is low compared with the maximum rate at −15°c Thus for the Ohio data the Bergeron process doe not apply while it may do so for the New Mexic data. It is suggested that Midwest aerosols fro industrial processes may provide enough hygroscopi nuclei to allow the development of precipitation b drop accretion as suggested by Ludlam. If tru different processes may occur in different geographica regions and so affect the effectiveness of cloud seedin R. S. REA

551.591.

9239. On the meteorological optics of haze and fog II. L. Fotzik. *Z. Meteorol.*, 4, 321–9 (*Nov.*, 195 *In German.*

For Pt I, see Abstr. 4810 (1952). The distributio of drop size is considered. In natural fogs the rang of drop radius is very variable but all can be expresse

the normal curve $y = e^{-A(\log\rho/r)^2}$ where y = relative frequency, ρ = radius, r most frequent radius and A in North Sea fog varies from 15 to 50, mean 27. The inference is that all nuclei are not equally effective and this is confirmed by experiments with a cloud chamber with different degrees of dilatation. The Watton–Houghton function for loss of light with drops of equal radius (Pt I) is recalculated for this drop-size distribution. METEOROLOGICAL ABSTRACTS

551.593.1

9240. Refractive index and refraction of atmospheric air. H. Socher. *Arch. Meteorol. Geophys. Bioklimatol. B*, **3**, 270–4 (1951) *In German.*

Author recalculated P. Harzer's 1924 tables of the refraction constant for astronomical use for determinations by H. Barrell and J. E. Sears (1939) for 0–600μ. A table of corrections for the most effective visual wavelengths of 5 spectral types of stars is included. METEOROLOGICAL ABSTRACTS

551.593.5

9241. A method for the determination of atmospheric transmission functions from laboratory absorption measurements. S. N. Plass. *J. Opt. Soc. Amer.*, **42**, 477–83 (*Sept.*, 1952).

It is shown that the average transmission function of the atmosphere can be calculated from the fractional absorption as measured in the laboratory for frequency intervals involving either large or small optical thicknesses. These relations are very general and are independent of any special assumptions as to the shape of the pressure broadened lines, of the variation of spacing, intensity, or half-width of the lines, of the extent of the overlapping of the lines, or of the distribution of the radiating gases in the atmosphere. The optical thickness is considered large or small for a particular interval depending on the intensities and half-widths of the lines contributing to the absorption. The solutions of radiation transfer problems can be obtained from the average transmission function calculated by the above method. A number of examples are given of the application of these results to particular problems. It is shown that in general for pressure broadened lines the fractional absorption is a function only of pressure times optical thickness for large optical thicknesses, and of optical thickness times a function of the pressure for small optical thicknesses. A.

551.594 : 538.5

An electromagnetic interpretation problem for the ionosphere. *See Abstr.* 8949

551.594.12

9242. Height variations in the concentration of ions near the ground during quiet summer nights at Uppsala. H. Norinder and R. Siksna. *Tellus*, **3**, 234–9 (*Nov.*, 1951).

Results of measurements of the concentration of small- and large-ions at different heights near the ground during quiet summer nights at Uppsala are given. Characteristic shapes for the variation of the concentration of ions are illustrated. At the ground the concentration of small ions increases more than at higher levels, where also an enhanced content of small ions can be observed during the stated weather conditions. The number of large ions decreases after sunset reaching a minimum at sunrise, after sunrise a comparatively rapid increase follows. It seems that the concentration of large ions near the ground is actually a little below that at the higher levels. Preliminary explanations of the variations are outlined. A.

551.594.12

9243. Variations of the concentration of ions at different heights near the ground during quiet summer nights at Uppsala. H. Norinder and R. Siksna. *Ark. Geofys.*, **1**, 519–41 (*Paper* 18, 1952).

An investigation of the concentration of small and large positive ions in the first two metres of the atmosphere. The concentration of small ions increases rapidly at sunset and then remains nearly constant until around sunrise when there is a rapid decay. The large positive ions decrease from sunset to sunrise and then rise rapidly. It is suggested that the effect is caused by the accumulation of emanation exhaled by the soil and its decay products. J. M. HOUGH

551.594.21

9244. On the origin of electric charges by processes in the crystalline ice phase. A. Kumm. *Arch. Meteorol. Geophys. Bioklimatol. A*, **3**, 382–407 (1951) *In German.*

A laboratory examination of results by W. Findeisen (1940, 1943) does not confirm them. Rime was formed on an upper cold hemispherical surface, from which particles fell off under certain conditions such as variations of temperature. Charges on these particles were studied; they increased rapidly in frequency from 25×10^{-15} coulomb to $3{\cdot}5\times10^{-15}$ more slowly to $3{\cdot}3\times10^{-16}$, then remained constant. Mean charge 7×10^{-16}. At all levels + charges are 7–8 times as frequent as − charges. A possible new explanation is discussed, based on polarity of ice needles. The charges developed are too small to account for electricity of thunderstorms.

METEOROLOGICAL ABSTRACTS

551.594.21

9245. Variations of the electric field in the vicinity of lightning discharges. H. Norinder. *Ark. Geofys.*, **1**, 543–70 (*Paper* 20, 1952).

Simultaneous oscillographic records are obtained of the field changes caused by lightning strokes at distances up to ~40 miles from two stations ~10 miles apart. The measuring equipment is briefly described and the mechanism of the development of the radiation terms of the field change is examined. 1445 oscillograms were analysed and these are subjected to a physical and statistical analysis. Three types of pre-discharges (caused by leader strokes) are distinguished, all three being characterized by a predominant oscillation of ~28 kc/s. Typical similarities and differences between simultaneous records of the main field changes (due to the return stroke), and recorded at the 2 stations, are discussed. Superimposed rapid oscillations are believed to be due to simultaneous pre-discharges in other storm centres. Statistical data are presented of the duration and amplitude of field changes due to precursors and main discharges, as well as the polarity and frequency of oscillation involved. R. H. GOLDE

551.594.221 : 621.316.98

9246. Electrodynamic considerations of lightning problems. S. SZPOR. *Trans Soc. Sci. Varsovie, VI*, **2**, 27 *pp.* (1952).

A new conception of the lightning leader stroke is developed in which this is deemed to be charged by e.s. induction of the field existing between cloud and earth. Several simplifying assumptions lead to an approximate evaluation of the charge distribution along the leader channel both in a uniform and in a certain non-uniform predischarge field. From e.m. considerations the current flowing in the leader stroke is derived. The treatment is qualitative but quantitative results are obtained for a relation between leader current and velocity of propagation of the leader discharge for different values of cloud potential.

R. H. GOLDE

551.594.221 : 621.396.9

9247. Radio echoes and lightning. V. G. MILES. Letter in *Nature* [*Lond.*] **170**, 365–6 (*Aug.* 30, 1952).

A vertically directed radar beam investigating a passing thundercloud produced several echoes which occurred simultaneously with lightning flashes. It is suggested that the echoes originate from ionized portions of the cloud charge. R. H. GOLDE (R)

551.594.25

9248. Electric charges of rain-drops. S. K. BANERJI AND S. R. LELE. *Proc. Nat. Inst. Sci. India.*, **18**, 93–124 (*March–April*, 1952).

The recording equipment described includes a Wilson tilt electroscope for recording the charge on individual rain drops. A Simpson apparatus giving the charge on rain collected every 2 min and an ionium collector for continuous recording of the earth's electric field were kept in simultaneous operation. A number of specimen records obtained during and in the absence of thundery conditions are reproduced and the data obtained in 1931–32 in Bombay and in 1935–36 in Poona are tabulated. Both pos. and neg. charges are found to be present on rain drops from any part of the cloud. The mean charge of pos. drops is 0·021 e.s.u. in non-thunderstorm rain and 0·051 in thunderstorm rain, the equivalent mean charges of neg. drops being 0·023 and 0·057 e.s.u. respectively. It is shown that, initially, cloud particles develop charge in the same way as colloidal particles or particles floating in a medium and capturing ions. These initial charges are augmented by the Simpson process of the break-up of rain drops. At height above the freezing level the collision of ice particles is believed to make these negatively charged. R. H. GOLDE

551.594.6 : 621.396.821 : 621.317.7

9249. An automatic atmospherics recorder. B. A. PI TANTRY. *J. Sci. Industr. Res.*, **11B**, 218–20 (*June*, 1952).

Short account of the various elements of a recorder designed for the automatic recording of wave-form of natural and artificial atmospherics. The uni incorporates aperiodic amplification, cathode-ray recording, continuously variable phase and amplitude of e.m.f., and a transient generator for test purposes. Examples are given of oscillograms obtained with the recorder. G. M. BROWN

BIOLOGY 57/59

578.088.5

9250. Effects of beta radiation on the gastric mucosa of dogs. D. M. DOUGLAS, W. R. GHENT AND S. ROWLANDS. *J. Chim. Phys.*, **48**, 249–51 (*May–June*, 1951).

Some observations on the reduction in acid levels in the stomachs of dogs in which the gastric mucosa has been exposed to β-radiation are reported. The irradiation is given by using P^{32} in inflatable balloons and a discussion of suitable techniques for satisfactory irradiation is given. H. MILLER

578.088.5

9251. The application of radiocarbon in the study of radiolesions. G. HEVESY. *J. Chim. Phys.*, **48**, 275–9 (*May–June*, 1951).

Observations on the effect of ionizing radiations on the rate of incorporation of C^{14} into various chemical components of animal tissues are described. The influence of changes in the specific activity of these substances is discussed. It is suggested that valuable information on biochemical changes produced by ionizing radiation can be obtained by this kind of study. H. MILLER

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612 : 621.317.311

9252. Measurement of slowly varying unidirectional currents in electrophysiological research. A. MANFREDI. *R.C.* 51 *Riun. Ass. Elettrotec. Ital.* 1950 *Fasc.* 2, 383–6 (*Paper* 163, 1951) *In Italian.*

The current to be measured is passed between diametrically opposite terminals of a continuously wound toroidal resistance. A moving contact driven at 10–20 rev/sec generates an alternating potential which is amplified electronically and measured by a diode voltmeter. F. F. ROBERTS (R)

612.843.31

9253. Influence on color perception of adaptation to illumination. R. W. BURNHAM, R. M. EVANS AND S. M. NEWHALL. *J. Opt. Soc. Amer.*, **42**, 597–609 (*Sept.*, 1952).

Six experienced observers made consistent determinations of various colours which appeared the same with adaptation to W light and to artificial daylight. These observations were made with each eye viewing a different colour patch and with the patches appearing juxtaposed at the middle of a fused binocular field. The method was to make the two juxtaposed patches match by adjusting one of them, sometimes when both eyes were adapted to the same illumination and sometimes to the different illuminations. Plots of the data in the CIE chromaticity diagram indicate a systematic shift in colour appearance toward the blues when adaptation was changed from daylight to W; or toward the yellows when adaptation was changed from W to daylight. The magnitude of this colour shift was substantial, at least in the considerable

lour region investigated, for here the average igth of the representative vectors was 0·10 in CIE ms or of the order of 20 just perceptible colour ferences. Qualitatively, the results confirm those Hunt and of Winch and Young. The theoretical plications will be discussed in a later paper. A.

612.843.31

54. Color and the intensity-time relation. R. O. OUSE. *J. Opt. Soc. Amer.*, **42**, 626–30 (*Sept.*, 1952). Measurements of the intensity necessary for monolar differential thresholds for red, green and blue st lights were made at exposures of the test light nging from 0·002 to 1·000 sec. Central fixation as used, the coloured test light appearing as a small ot brighter than the surrounding, white-lighted field. he adaptation brightness was just above the cone reshold. Adaptation was controlled over 40 degrees the visual field, including the very centre. Three lected subjects, with normal colour vision and acuity, ntributed approximately 1000 threshold determinaons. The method of limits was used. It was found at there were no differences among the critical urations for the 3 colours. A.

612.843.613

255. Influence of the state of adaptation of an eye n the differential threshold of the eye. I. M. AGUILAR ND M. SOLÍS. *An. Real. Soc. Esp. Fis. y Quim.*, 7 (A) 303–7 (*Nov.–Dec.*, 1951) *In Spanish.* The Pulfrich photometer is employed. In this first aper the existence of such an influence is discussed, bserving that in the case of the best possible lumince of the interfering eye the improvement in the ifferential threshold reaches values up to 27%. A.

612.843.613

256. Studies of psychophysical methods for measurg visual thresholds. H. R. BLACKWELL. *J. Opt. oc. Amer.*, **42**, 606–16 (*Sept.*, 1952). The comparative adequacy of various psychohysical procedures employed to measure visual hresholds has been investigated. Adequacy is lefined by: (*a*) reliability; (*b*) inferred validity; and (*c*) sensory-determinacy. Reliability refers to the xtent to which repetitions of measurements made nder presumably identical experimental conditions iffer from each other. Inferred validity refers to the xtent to which measurements depend upon variables which are generally conceded to be irrelevant to the isual functions of interest. Sensory-determinacy efers to the absolute magnitude of the threshold. The ower the threshold, the more sensory-determinate it s considered to be. Procedural variables which have been studied include the response utilized by the subject to indicate discrimination; the number, spacing and order of light intensities presented in the measurement series; the general attitude which the subject adopts; and the extent to which the subject is given knowledge of the correctness of his responses. Psychophysical procedures have been found which appear to have optimum reliability, validity and sensory-determinacy. A.

612.843.613

9257. On the integrate capacity in time and space of the human peripheral retina. M. A. BOUMAN AND G. VAN DEN BRINK. *J. Opt. Soc. Amer.*, **42**, 617–20 (*Sept.*, 1952).

Measurements of the chance of interaction for a light perception of two stimuli projected at various distances in time and place from each other in the dark-adapted human peripheral retina are presented. The two separate test stimuli were about 2′ of angular size and each lasted 0·01 sec. The time τ between these two was varied from 0 to 0·21 sec, the distance δ between them 0–25 min of arc. The chance of interaction was measured by determination of the chances of observation for each test stimulus apart, and for $\tau = \delta = 0$. The colours of the light from the separated stimuli were red and green, for red chiefly the cones being active and for green, the rods. In the study, one test stimulus activated the rods, in the other the cones were included. It proved that the chance for interaction is described by $p(\tau) \cdot q(\delta)$; $p(\tau)$ does not depend on the place on the retina used or on the kind of receptors stimulated by the two test flashes. $q(\delta)$ depends on the position of the retina and the kind of receptors concerned in agreement with the well-known facts of the validity of Ricco's law. For mixed-rod cone vision $q(\delta)$ is situated intermediately between $q(\delta)$ for pure cone and pure rod vision on the position of the retina under consideration. Eccentricities from 5° up to 27° from the fovea are used. The results are discussed in relation to outstanding details of the two-quanta explanation of the absolute thresholds. A.

612.843.63

9258. Visual acuity: its dependence on the length of the test object. I. J. M. OTERO, M. AGUILAR AND M. SOLÍS. *An. Real Soc. Fis. y Quim.*, **47** (A) 289–94 (*Nov.–Dec.*, 1951) *In Spanish.*

Theoretical reasons, based on the quantum theory of vision, are advanced as to why visual acuity (v.a.) as measured by the distance between two parallel lines should depend on their length: above a definite length no improvement is expected. A difference is also made between v.a. by point and line measurements respectively. The theory leads to a distinction between v.a. and contrast measurements. Experimental data are given in its support. 9 figs and 1 table. R. A. WEALE

612.843.63

9259. Visual importance of the spectral components of white light. D. Y. SOLANDT, R. E. WHITE AND P. S. ROSEN. *Illum. Engng* [*N.Y.*] **47**, 435–44 (*Aug.*, 1952).

Visual acuity was measured under seven different kinds of illumination of markedly different spectral compositions but all giving the sensation of white. The luminance (brightness) was 10 foot-lamberts. No significant difference was found. J. W. T. WALSH

612.843.63

9260. Visual acuity, contrast, and flicker, as measures of retinal sensitivity. R. H. PECKHAM AND W. J. ARNER. *J. Opt. Soc. Amer.*, **42**, 621–5 (*Sept.*, 1952).

Visual acuity at three contrasts and two brightnesses and critical flicker frequency (CFF) at two brightnesses, were measured morning and evening on 24 subjects for five successive days. During the days

the subjects drove automobiles for several hours, in the brilliant sunshine of the Arizona desert. Statistical analysis of the results shows that the acuity and flicker measurements have high correlation, but that the inherent variance of visual acuity measurements is great, while that of CFF is small. The CFF can be used to develop a logarithmic index of retinal sensitivity. Application of this index to the effect of exposure to sunlight is exemplified. Other applications are suggested. A.

612.85

9261. In search of the missing 6 db. W. A. MUNSON AND F. M. WIENER. *J. Acoust. Soc. Amer.*, **24**, 498–501 (*Sept.*, 1952).

The unexplained difference in sound pressure in the ear canal which appears to exist when equally loud low frequency tones are presented alternately from an earphone and from a loudspeaker has bedeviled acousticians for many years and, unfortunately, still continues to do so. There are presented here the results of some of the measurements carried out at the Bell Telephone Laboratories which show the magnitude of the effect and various attempts at explaining it. While no satisfactory explanation has been found, it is hoped that publication of these results will stimulate interest in the problem. A.

612.85

9262. The masking of tones by white noise as a function of the interaural phases of both components. I. 500 cycles. L. A. JEFFRESS, H. C. BLODGETT AND B. H. DEATHERAGE. *J. Acoust. Soc. Amer.*, **24**, 523–7 (*Sept.*, 1952).

Work by Hawkins, Hirsh, Licklider, Stevens, Webster and others has shown the considerable reduction in masking which occurs when the interaural phase of either the signal or the noise is reversed, or when the interaural phase of the signal is shifted by various amounts. The present paper extends this work by shifting the interaural phases of the masking component of the noise and of the tone by various amounts between $+180°$ and $-180°$, and also by shifting the noise timewise by amounts up to 4·0 msec. The interaural phases of both the noise and the 500∼ tonal signal are therefore parameters of this study. The results are in agreement with those already published, but show in addition large reductions in threshold even when the noise and the tone differ in their interaural phase positions by amounts less than 180°. They also show a periodic fall and rise of the masked threshold as the interaural time difference for the noise is varied. Finally, they show the importance of interaural correlation in determining the extent to which the binaural threshold will be lower than the monaural. A.

612.858

9263. The space-time pattern of the cochlear microphonics (guinea pig), as recorded by differential electrodes. I. TASAKI, H. DAVIS AND J.-P. LEGOUIX. *J. Acoust. Soc. Amer.*, **24**, 502–19 (*Sept.*, 1952).

Pairs of very small electrodes were placed in two or more turns of the cochlea of the guinea pig. The cochlear microphonic from a short segment (about 1 mm) of the cochlear partition can thus be recorded, and without contamination by action potentials. The outputs of the 2nd, 3rd and 4th turns were compared with that of the 1st turn with respect to both amplitude and phase as a function of frequency. The space-time pattern thus revealed is a travelling wave which passes up the cochlea to a distance that depends on the frequency. The pattern agrees well with that of mechanical movement (Békésy) except that the cochlear microphonic shows relatively greater amplitude (voltage) in the basal turn. Low frequencies travel farther up the cochlea than do high. The velocity (for a 750 c/s tone) is about 100 m/sec in the basal turn and about 2 m/sec in the 4th turn. Phase differences of as much as 5π were observed by means of Lissajous patterns, between the responses of the 1st and 3rd turn. Certain discontinuities in the input-output relationships and in phase relationships were found to be a function of frequency and of position along the cochlear partition. These discontinuities occurred at or near the frequencies that showed a phase difference of 2π from the basal end of the cochlea. The relation of these critical frequencies to position along the cochlea constitutes a new "frequency-map" of the cochlea. The space-time pattern of the cochlear microphonic proved to be very little affected by removal of portions of the bony wall of the cochlea or delivering acoustic energy through a hole near the apex. It is concluded that in addition to "direct driving" of the cochlear partition by pressure differences between the two scalae and to "surface waves" arising from such driving, the transmission of transverse waves along the solid structures of the cochlear partition must also be included for a satisfactory interpretation of all of the available data. A.

612.858

9264. Dimensions of the cochlea (guinea pig). C. FERNÁNDEZ. *J. Acoust. Soc. Amer.*, **24**, 519–22 (*Sept.*, 1952).

Measurements have been made under the microscope of many structures in the cochlea of the guinea pig and the results plotted graphically as a function of position along the cochlea. The structures measured are the spiral lamina, Rosenthal's canal, the basilar membrane (length, width and thickness), the channels and windows of the cochlea (cross section area) and the hair cells (angles of orientation). A.

612.858

9265. Brownian motion and the transmission of energy in the cochlea. H. L. DE VRIES. *J. Acoust. Soc. Amer.*, **24**, 527–33 (*Sept.*, 1952).

It is shown that Brownian motion at the eardrum is only partly due to noise of the air (this part has been calculated by Sivian and White). The main part is due to Brownian motion of the eardrum itself. The apparent flow of energy is close to the absolute threshold of the ear; it is reduced to one half when the ear is provided with an exponential horn. The discussion of the Brownian noise in the inner ear reveals a serious discrepancy; considering one individual cell it proves to be very difficult to reconcile the low threshold with the thermal agitation. A mechanism is suggested for the excitation of the sense cells by which the disturbances by Brownian motion

ure appreciably suppressed; in this model the microphonic activity plays an important part. The model is based on some recent measurements of the microphonic activity of the lateral line organs of fishes, which are shortly summarized. It follows from these measurements that the microphonic potentials are related with the tension of the hairs on the sense cells. A.

614.898

9266. Protection from whole body irradiation by chemical means. R. H. MOLE. *J. Chim. Phys.*, **48**, 258–61 (*May–June*, 1951).

Whole body X-radiation has been given to mice and the influence of previous injections of thiourea and other compounds on the survival rates has been studied. Thiourea given immediately before irradiation causes a reduction in mortality. The influence of thiourea on other radiation effects was examined in an attempt to elucidate the mechanism of its action. H. MILLER

614.898

9267. Studies on the problem of protection against the effects of X-rays. A. FORSSBERG. *J. Chim. Phys.*, **48**, 262–3 (*May–June*, 1951).

The use of cystein as a protective material against the effects of X-rays is illustrated by experiments on the growth rates of certain bacteria and on epilation effects on guinea pigs. The effect of cystein on the depression of nucleic acid synthesis following irradiation of mice is also briefly described. H. MILLER

614.898

9268. Cytological investigation of bone marrow of mice after administration of protective agents and subsequent X radiation. F. DEVIK. *Brit. J. Radiol.*, **25**, 481–4 (*Sept.*, 1952).

Mice were exposed to 200 r total body radiation, and the frequency of chromosome injuries induced by radiation in the bone-marrow was determined. The effects of pre-radiation administration of cysteine, glutathione, thiocholine, thiourea, ascorbic acid, methylene blue, vitamin B_1 on the frequency of chromosome abnormalities were studied. There was no significant reduction in chromosome injury with these substances. Mice were irradiated under hypoxia, and the amount of chromosome injuries was reduced as compared with the control. It is concluded that the protective effect of cysteine and other substances, which reduce mortality rate after radiation, is exerted in the cytoplasm, while that of hypoxia may be more specifically restricted to the chromosome mechanism. A.

614.898 : 539.16.08

9269. Radiac instrumentation. D. TAYLOR. *J. Sci. Instrum.*, **29**, 315–21 (*Oct.*, 1952).

A description is given of the main types of radiation monitoring instruments, usually called "radiac" instruments, which would be required by the civil defence authorities in the event of atomic warfare. The instruments discussed include the flash dosemeter, individual dosemeter, dose-rate meter and contamination meter. In each case, an account is given of the purpose of the instrument and the performance characteristics required, and some typical designs are mentioned. The paper concludes with an appendix giving the approved specifications for each instrument discussed. A.

615.849 : 537.531.08

9270. A generalised method of rapid dosage estimation with particular reference to 200 kV therapy. B. W. WORTHLEY AND B. M. WHEATLEY. *Brit. J. Radiol.*, **25**, 491–501 (*Sept.*, 1952).

The method relies on the analysis of the Mayneord–Lamerton survey data into primary and scatter contributions. For points not on the central axis the scatter contribution is a function of the position in the field. By suitable choice of coordinates it is shown that the ratio of the dose due to scatter at a given point can be easily related to the central axis scatter. The ratios were determined experimentally by means of an optical integrating machine previously described, and are tabulated for fields of simple shape, including circles, squares, rectangles and some triangles. The consistency of the method is examined and one of the examples is chosen so that it may be checked against recently published direct measurements and against the result of calculations using Meredith and Neary's method. It is also shown how many fields of complex shape, such as are produced by adjustable diaphragm devices or by partial masking of regular fields, can be treated by taking them as combinations of fields already discussed. A.

615.849 : 537.531.08

9271. The flattening of wedge isodose curves in the direction perpendicular to the wedge. L. A. W. KEMP AND R. OLIVER. *Brit. J. Radiol.*, **25**, 502–4 (*Sept.*, 1952).

Flattening of wedge isodose curves in a direction perpendicular to the wedge ensures the maintenance of the central-plane wedge field summation over practically the whole field dimension. A compensating filter of Perspex, thick in the centre of the field and tapering towards the field edges in the non-wedge direction, produces satisfactory flattening without materially affecting the wedge isodose curves. Filters suitable for use with 5×15 cm and 6×8 cm wedge fields are described by way of example. A.

616–073.75 : 539.166.94

9272. Multichannel collimators for gamma-ray scanning with scintillation counters. R. R. NEWELL, W. SAUNDERS AND E. MILLER. *Nucleonics*, **10**, 36–40 (*July*, 1952).

The use of a multichannel γ-ray collimator for locating small tumours, activated with I^{131} located near the brain centre is discussed. L. R. SHEPHERD

TECHNICAL MATERIALS 66/67

66 : 539.167.3

9273. Radioactive isotopes applied in technical development. G. ANIANSSON. *Tekn. Tidskr.*, **82**, 604–6 (*June* 30, 1952) *In Swedish.*

As example of application of tracer technique to the study of catalytic reactions, the use of C^{14} for determining the intermediate stage in the Fischer–Tropsch process is explained. It appears that it is alcohol adsorbed on the catalyst which forms the intermediate product. The determination of cation adsorption in washing and laundering processes, of adsorption of solutes on solids, fibre streaming in paper manufacture, and various analytic problems, are discussed. The application to the study of low vapour pressures and of processes of friction is described, and some notes on the measuring-instruments are given. J. A. WILCKEN

669 : 539.167.3

9274. Radioactive isotopes in metallography. M. HILLERT. *Tekn. Tidskr.*, **82**, 610–12 (*June* 30, 1952) *In Swedish.*

Autoradiographic methods are particularly suitable in metallographic studies. Applications to the diffusion of Ag in Ag, distribution of Pb in stainless steel, and solubility of S in Fe, are discussed. J. A. WILCKEN

669 : 539.167.3 : 622

9275. Radioactive isotopes in mining and metallurgy. L.-G. ERWALL. *Tekn. Tidskr.*, **82**, 606–10 (*June* 30, 1952) *In Swedish.*

Natural radioactivity, which differs for different minerals, has been extensively used for determining minerals traversed by a borehole, by moving a recording counter from the bottom to the top. An example of a record is shown. A neutron logging method for distinguishing porous and non-porous rock is described. Metallurgical applications of tracer technique include study of reaction kinetics in flotation processes, sorption of xanthate on metal specimens, sorting of minerals by a radiation detector using natural or induced radioactivity, control of furnace processes and gas velocity, determination of sulphur content in steel, and various analytical problems. J. A. WILCKEN

PHOTOGRAPHY 77

771.416 : 621.316.722 : 621.383

9276. Photographic exposure timers providing compensation for supply-voltage variations. R. J. HERCOCK AND D. M. NEALE. *Proc. Instn Elect. Engrs, Pt II*, **99**, 507–14 (*Oct.*, 1952).

For blue-sensitive photographic materials the effective intensity of light from a tungsten-filament lamp is roughly proportional to the fifth power of the applied voltage. To compensate for variations in voltage, electronic timing circuits with simple circuit elements have been developed to effect exposure intervals which are $\propto$ (supply voltage)$^{-5}$. With a timer of this type, provided that it is connected to the same supply as the lamp, the exposure (intensity $\times$ time) given will be substantially independent of the supply voltage. All the circuits described include *RC* timing elements, and exposures are adjusted by varying the resistance. For moderate supply-voltage fluctuations, sufficient compensation can be provided by varying, in accordance with the supply voltage, either the charging potential, the bias of the relay valve or the initial charge on the condenser. Wider voltage ranges can be covered by using two of these methods simultaneously. A circuit is described which is applicable to any a.c. supply within the range 100–250 V. The exposure time at the nominal supply voltage is continuously adjustable from 1 sec to 1 min or more, and voltage deviations of from $+15$ to -20% from the nominal value do not change the intensity-time product by more than $\pm 5\%$. A.

771.53

9277. Russel effect and photographic emulsions. V. P. NARAYANAN NAMBIYAR. Letter in *Curr. Sci.*, **21**, 182–3 (*July*, 1952).

See Abstr. 2839 (1950). The effect of wood on photographic emulsions seems to be due to emitted vapours, and is shown best on non-colour-sensitive material. S. T. HENDERSON

771.53

9278. Contributions on the mechanism of stabilization of photographic emulsions. I. Previous views on the mechanism of the stabilization process. E.-J. BIRR. *Z. wiss. Photogr.*, **47**, 72–83 (*No.* 4–6, 1952) *In German.*

A critical review of earlier work with numerous references. S. T. HENDERSON

771.53

9279. Studies by nephelometry of the physical ripening of the chloride emulsion. F. EVVA. *Z. wiss. Photogr.*, **47**, 84–105 (*No.* 4–6, 1952) *In German.*

The turbidity of the diluted emulsion was measured through red and blue filters, and the ratio of the logs of the two values taken as an index of the dispersion, whence the particle size (volume) could be found from a calibration curve. Emulsions were made in 1% gelatin, and the effects on growth of the AgCl particles studied with respect to different gelatins, temp. of ripening, excess of chloride present, concentration of AgCl, pH, and the use of $CdCl_2$. Growth at constant temp. is approx. exponential to a maximum value; increase of temp. increases the rate though different gelatins act differently. Cd ions or an excess of chloride decrease the rate of ripening, whereas an increase of AgCl concentration generally produces a curve with a max. Different gelatins are also distinguished by their effects with change of pH, but there is little relation to the corresponding viscosity changes. Previous work is discussed. S. T. HENDERSON

771.534.55

280. The estimation of photographic resolving power from visual observations alone. P. G. POWELL. *J. Sci. Instrum.*, **29**, 313–14 (*Oct.*, 1952).

The properties of a photographic material which affect its resolving power can be simulated by optical devices producing diffusion and a "grainy" pattern on the image. On this basis an apparatus has been constructed with which purely visual estimates of resolving power are obtained which correlate with photographic measurements. A.

778.3 : 535.327.3

281. A sharp-focusing schlieren system. A. KANTROWITZ AND R. L. TRIMPI. *J. Aeronaut. Sci.*, **17**, 311–14, 319 (1950).

A schlieren system with multiple sources and corresponding cut-offs is described. Each source-cut-off combination produces an independent schlieren image, and, for a given screen position, only the shadows produced by density gradients at a single plane in the flow superpose exactly. In general, for planes out of focus, offset superposition of the images blurs out the effects of density gradients not in the focal plane by a process similar to the focusing of ordinary lenses. In its present state of development, the sharp-focusing schlieren system is not very effective near opaque walls parallel to the optical axis—for boundary-layer studies—since only grazing rays can be utilized in this case. The performance of a model sharp-focusing schlieren system is illustrated by a series of photographs of a jet and a flame positioned along the optical axis. It is shown that photographs can be taken of the jet undisturbed by the presence of the flame, and vice versa. A series of photographs of a normal shock wave in a nozzle are shown and compared with a conventional schlieren photograph. Some of the more important problems in construction and adjustment are discussed.

PHOTOGRAPHIC ABSTRACTS

778.33

282. Use of a gamma-ray pinhole camera for *in vivo* studies. H. O. ANGER. Letter in *Nature [Lond.]* **170**, 200–1 (*Aug.* 2, 1952).

Using a lead pinhole of $\frac{1}{8}$ in dia. and a large crystal $\frac{1}{8}$ in thick as intensifying screen, γ-ray photographs of I^{131} in a tumour (20 mC) have been obtained with 1 hr exposure. F. T. FARMER

778.33

283. Microradiography with alpha-rays. G. ANIANSSON AND N. STEIGER. Letter in *Nature [Lond.]* **170**, 201–2 (*Aug.* 2, 1952).

A beam of α-rays from 3·5 mC polonium is used to study thickness patterns of biological sections.

F. T. FARMER

778.33 : 535.317.1 : 537.531

Effect of focal spot size on shape and structure of X-ray images. *See Abstr.* 8883

778.34

284. The clearing of nuclear track plates. C. DILWORTH, G. OCCHIALINI AND E. SAMUEL. *Bull. Cent. Phys. Nucléaire, Bruxelles, No.* 2, 2 *pp.* (*Aug.*, 1948) *In French.*

The development stain which is produced in thick nuclear track emulsions when full development is given, can be cleared by alternate bathing of the plates in dilute HCl and in hypo. Photomicrographs are shown illustrating the results of such treatment.

A. C. COATES

778.34

9285. Discrimination of charged particles in nuclear track plates. M. MORTIER AND L. VERMAESEN. *Bull. Cent. Phys. Nucléaire, Bruxelles, No.* 5, 5 *pp.* (*Dec.*, 1948) *In French.*

The discrimination between α-particles and protons, and between α-particles and tritons has been investigated in Ilford C.2 emulsions by the method described by Stevens [Abstr. 3632 (1949)]. The energies of the α-particles and tritons obtained from the reaction $Li^6(n, \alpha)H^3$ have been measured and compared with the values obtained by other workers who used the fading effect to obtain discrimination. A. C. COATES

778.34

9286. Distortion of nuclear emulsions. M. G. E. COSYNS AND G. VANDERHAEGHE. *Bull. Cent. Phys. Nucléaire, Bruxelles, No.* 15, 4 *pp.* (*April*, 1951) *In French.*

A coefficient has been defined which enables the distortion of a processed nuclear track emulsion to be measured. The apparent curvature produced by distortion in tracks recorded in the emulsion can be calculated with the aid of this coefficient.

A. C. COATES

778.34

9287. Eradication of proton tracks in G5 nuclear emulsions. L. WINAND AND C. BEETS. *Bull. Soc. Roy. Sci. Liège*, **21**, 115–18 (*March*, 1952) *In French.*

Two hundred micron G5 plates were exposed to high-energy protons and some were then placed in a humid atmosphere at 35°c for 50 hr. The degree of track fading achieved was strongly dependent on residual range and on depth in the emulsion. In the upper layers of the emulsion the grain densities were reduced by factors of ~2 and ~4 at residual ranges of 25 and 1075 microns respectively. In the lower half of the emulsion the factors became ~1 (unaffected) and ~1·3 respectively. J. J. WILKINS

778.34

9288. Study of several physico-chemical factors influencing the length of tracks in nuclear emulsions. H. BRAUN. *J. Phys. Radium*, **13**, 347–54 (*June*, 1952) *In French.*

Using 50 μ Ilford emulsions to record α-particles, range measurements made by different observers are consistent. Under-development of the plates, as employed for the discrimination of heavily ionizing particles, produces a slight reduction in the track length. The stopping power of lithium-loaded plates is the same as for ordinary plates, but that of boron is decreased by 1·4%. The variation of stopping power with humidity is less than 1% for humidities $\leq$ 58% R.H. The stopping power of Ilford E_1 plates is slightly less than that of the C_1 plates which in turn is slightly less than that of the D_1 plates. Values are given for the range in E_1 and C_2 plates of the α-particles emitted by ThC′ and ThA. A. C. COATES

778.34 : 537.533

9289. Electron track recognition in nuclear emulsions. A. BEISLER. Letter in *Rev. Sci. Instrum.*, **23**, 500–1 (*Sept.*, 1952).

By superimposing representations of low-energy electron tracks on to artificial fog backgrounds of various densities, the likelihood of track recognition was determined as a function of the fog level. At fog densities of 5×10^{-3} grains/micron^2 and above, a definite proportion of tracks are not recognized and a number of pseudo-electron tracks are observed.

A. C. COATES

778.34 : 537.534.74 : 535.822

Microscopes for the measurement of scattering in nuclear plates. *See Abstr.* 8824

778.34 : 539.164

9290. Calculation of range-energy relations for alpha-particles in photographic emulsions. M. BOGAARDT AND B. KOUDIJS. Letter in *Phys. Rev.*, **87**, 1129 (*Sept.* 15, 1952).

A semi-empirical range-energy curve was calculated for α-particles in the Ilford C2 emulsion, using Bethe's energy loss formula, in which the average excitation potential I is replaced by an empirical quantity J for the heavy elements. The calculated and experimental range-energy curves are in close agreement, which indicates that the J values obtained can be used to calculate range-energy curves for other types of emulsion.

A. C. COATES

778.37

9291. Double-flash microsecond silhouette photography. H. E. EDGERTON. *Rev. Sci. Instrum.*, **23**, 532–4 (*Oct.*, 1952).

Equipment is described to take double-exposure silhouette photographs of rapidly moving objects. Each exposure time is about $\frac{1}{2}$ μsec, and the time interval between flashes is adjustable. An 8 in square Ektalite Fresnel lens is used as a field lens to focus the light from the illuminating spark into the camera lens; it is especially useful for subjects where the lens is frequently damaged. Timing of the first spark is conveniently made for explosions by a photoelectric tube triggered by the light of the explosion. A double exposure photograph of a dynamite blasting cap is given as an example.

A.

778.6

9292. Subtractive color reproduction: interimage effects. W. T. HANSON, JR AND C. A. HORTON. *J. Opt. Soc. Amer.*, **42**, 663–9 (*Sept.*, 1952).

A number of theoretical treatments of the problem of three-colour subtractive photographic reproduction have led to equations which express the required relationship between the amounts of the three dyes occurring in the reproduction and the red-, green- and blue-exposure densities of the subject photographed. "Exposure densities" were defined by Brewer, Hanson and Horton, as the densities of a particular object being photographed, measured with respect to the sensitivity distributions of the photographic process. Each dye must be a function of all three exposure densities. Subtractive colour photographic processes, in which no masking is used, are frequently assumed to produce a cyan-dye image as a function of red-exposure density, a magenta image as a function of green-exposure density, and a yellow image as a function of blue-exposure density. However, many processes have "interimage effects" which cause each dye image to be a function of all three exposure densities. Some of the interimage effects occurring in Kodak Ektachrome Sheet Film have been determined. The sensitometric characteristics of the film, including the interimage effects, have been expressed in the form of equations similar to the theoretical colour reproduction equations. A comparison of these two sets of equations indicates that most of the interimage effects occurring should give an improvement in colour reproduction over that which would be obtained in their absence.

A.